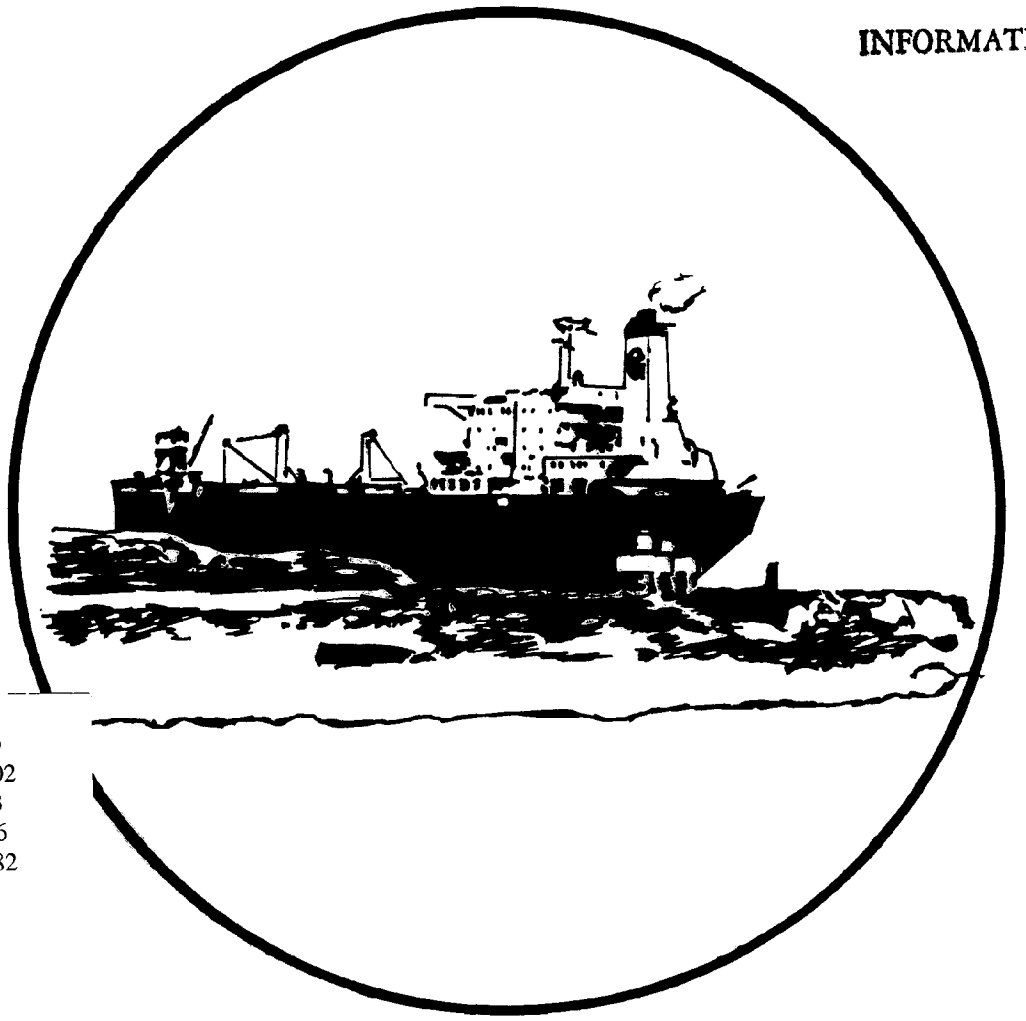
W.P.

COASTAL ENERGY ACTIVITY IMPACT ANALYSIS

FOR

DELAWARE CITY, DELAWARE

NOVEMBER, 1982



Delaware Coastal Zone Management Program

COASTAL ENERGY ACTIVITY IMPACT ANALYSIS FOR DELAWARE CITY, DELAWARE

BY

Andrew D. Zimmerman

Frank R. Selby

William J. Cohen

WILLIAM J. COHEN AND ASSOCIATES, INC.

WITH

David L. Manly

Charles E. Utermohle

Thomas E. Lynch

Andrew Smith

KIDDE CONSULTANTS, INC.

NOVEMBER, 1982

The preparation of this report was financed in part through a Coastal Energy Impact Program Grant from the Office of Coastal Zone Management, National Oceanic and Atmospheric Administration, under provisions of Section 308 (b) of the Coastal Zone Management Act Amendments of 1976 (Public Law 94-370).

ACKNOWLEDGEMENTS

Many individuals have generously provided their time, expertise, and perspectives on matters which have been important to the conduct of this Analysis. These individuals are gratefully acknowledged below. In addition, a special expression of gratitude is extended to Laura Newmarker, Bonnie Wingate, Carolyn Simmermon, and Sandy Rutkowski. Without their tireless efforts, this report could not have been produced.

Andrew D. Zimmerman
Project Director and Senior Associate
WILLIAM J. COHEN AND ASSOCIATES, INC.

CITY OF DELAWARE CITY
Richard Gilbert, former City Manager
Sylvia Maxey, City Manager
Carol Boyer, City Secretary
Joseph Daniels, Mayor
Carol Stewart, City Council
George Loebe, City Council
Patricia Harrison, City Council
Edward Kalinowski, City Council
Joseph Anderson, City Council
Yvonne McVey, CEIP Committee
Stephen D. M. Robinson, City Solicitor
John Nickle, CEIP Committee
J. Harry Nickle, former Mayor

GETTY REFINING AND MARKETING COMPANY
Raymond Arzinger, Vice President and Plant Manager
David Poffenberger, Industry and Legislative Relations Coordinator
James Maden, Fire Chief
William Tansey, Environmental Engineer

DELAWARE DEPARTMENT OF NATURAL RESOURCES AND ENVIRONMENTAL CONTROL
Robert French, Environmental Engineer
Michael Apgar, Supervisor, Water Supply Branch
Roy Parikh, Environmental Engineer, Water Resources Section
William Lawrence, Environmental Control Enforcement Supervisor
Jack Egolf, Environmental Protection Officer

WATER RESOURCES AGENCY FOR NEW CASTLE COUNTY
Bruce Kraeuter, Senior Engineer

DELAWARE GEOLOGICAL SURVEY, UNIVERSITY OF DELAWARE
Ken Woodruff, Senior Hydrologist

VISITING NURSES ASSOCIATION
Ann Pichett, Delaware City Health Clinic

DELAWARE CITIZENS FOR CLEAN AIR
Jacob Kreshtool, Esq., President
Arthur Seibel, Environmental Scientist

TABLE OF CONTENTS

TABLE OF CONTENTS, Continued

TABLE OF CONTENTS - Continued

LIST OF TABLES

LIST OF TABLES - Continued

LIST OF FIGURES

PART I

INTRODUCTION AND OVERVIEW

CHAPTER 1

PURPOSE OF THE STUDY

BACKGROUND: THE LOCATION OF THE GETTY REFINERY AT DELAWARE CITY

Early in 1954, officials of the Tidewater Associated Oil Company (subsequently to be named the Getty Oil Company) made a visit to Delaware City, a small and historic coastal community along the Delaware River. The purpose of their visit, during which they were joined by a representative of the Delaware Development Commission, was to evaluate the suitability of the Delaware City environs for the location of a new petroleum refinery, to replace the company's antiquated and heavily-taxed Bayonne, New Jersey, facility. All told, the company officials had investigated 30 sites along the Eastern Seaboard. They liked what they saw at Delaware City, and immediately initiated actions to acquire huge amounts of farmland at the edge of the town.

The result of their visit is a giant 140,000 barrel-per-day-capacity refinery, which has been operating at Delaware City since the spring of 1957. Although only of medium size by today's standards, the refinery was the largest to be built at one time when it first commenced operations 25 years ago. Moreover, it dwarfs everything else in the vicinity, situated on a property estimated to be one-half the area of the City of Wilmington. Its towers and other equipment dominate the sky for miles, and give the appearance of a brightly-lit city at night.

It would be preposterous to suggest that an industrial facility of such magnitude has had no significant effects on the life of its neighboring community over the years. Yet the refinery was planned and developed at a time when the notion of identifying and analyzing the impacts of large-scale development had not yet occurred to governmental and corporate decision-makers. Hence, the impacts that this installation may have created during the past 25 years have never been systematically evaluated, a situation which is relatively commonplace throughout the country, as well as in other parts of the world. Therefore, it has not been possible to determine whether the Getty refinery has had significant adverse or beneficial consequences for the people who reside in, work in, or visit Delaware City. Moreover, with the exception of isolated instances, it has never been revealed what might account for these impacts, including possible ways to reduce the adverse impacts and enhance beneficial ones.

THE COASTAL ENERGY ACTIVITY IMPACT ANALYSIS

As the result of Federal legislation enacted in 1976, the Coastal Zone Management Act Amendments (Public Law 94-370), public funds have been allocated to the protection of the nation's irreplaceable coastal resources. The Coastal Energy Impact Program (Section 308 of the Act) targets some of these funds for studies and other efforts to prevent, or at least reduce, adverse impacts on coastal communities resulting from the development of energy-related facilities.

In 1981, the City Manager of Delaware City made application, on behalf of the City, to the State Office of Management, Budget and Planning (OMBP), which administered these funds for Delaware, to obtain a grant under Section 308 (b) of the Act. Under the provisions of Section 308 (b), as stated in administrative regulations, Federal funds can be used "To design and implement projects to prevent or reduce unavoidable losses of environmental and recreational resources from coastal energy activities." The Getty refinery has been identified as a coastal energy activity.

During the fall of 1981, Delaware City was informed by the OMBP that a grant had been awarded to the City to conduct a Coastal Energy Activity Impact Analysis and

to implement strategies to address areas of identified impacts. The grant provided that a consultant would be hired to perform the work, since the City did not have the in-house capability and other resources necessary to conduct the project. Accordingly, a consultant selection effort was undertaken, and resulted in the selection of William J. Cohen and Associates, Inc., a planning firm based in Newark, Delaware. The Cohen firm retained the services of Kidde Consultants, Inc., an engineering firm based in Towson, Maryland, to perform portions of the work requiring engineering analysis. Work officially commenced in late December, 1981.

Based upon the Scope of Work agreed to by the Consultant, the City, and the OMBP, two phases consisting of five tasks would be completed, organized as follows:

Phase I - Coastal Energy Activity Impact Analysis

Task 1. Identification of Impacts
Task 2. Analysis of Impacts
Task 3. Recommendations

Phase II - Implementation

Task 4. Strategy Development
Task 5. Program and Grant Preparation

Phase I

The first phase, involving the actual conduct of the impact analysis, has been accomplished with a particular focus on the environmental and recreational/cultural resources of the community, in order to assess how these resources have been affected by the operation of the refinery. Twelve specific areas of potential impacts on these resources were identified by the Consultant for the purpose of accomplishing this analysis.

The report which follows presents the results of the analysis, including all beneficial and adverse (positive and negative) impacts which have been identified, and all recommendations which have been developed to address these impacts. The report has been organized to present these findings under two general categories: physical impacts; and social and economic impacts. Physical impacts have been defined to include:

- Shoreline erosion and flooding
- Air quality impact analysis, including odor analysis
- Water resources impact analysis
- Visual quality impact analysis
- Waterfront land use impact analysis

Social and economic impacts have been defined to include:

- History of the Getty-Delaware City relationship
- Community leadership assessment
- Health impact analysis
- Socio-economic impact analysis
- Community services and fiscal impact analysis
- Recreational and cultural opportunities impact analysis
- Potential for disaster impact analysis

Phase II

Based upon the identified impacts and the recommendations which have been developed to address these impacts, the Consultant is responsible for helping the community to implement strategies to make appropriate improvements in the community's quality of life. This effort, which is not included as part of the report, involves three primary thrusts:

1. Meetings with community leaders to formulate implementation strategies using a participatory approach;

2. The development of proposals for projects and programs which can be implemented to reduce negative impacts or enhance the benefits of positive impacts; and

3. The identification of potential sources of Federal, State, County, and private sector grants which might be obtained to help implement proposed projects and programs, and the submission of proposals on behalf of the City.

CHAPTER 2

GETTY OIL COMPANY OPERATIONS

PROFILE OF THE GETTY OIL COMPANY

The origins of the Getty Oil Company date from November 10, 1928, when the Pacific Western Oil Corporation, its predecessor, was incorporated in the State of Delaware. Over the ensuing years, the Company has pursued an ambitious program of acquisitions, mergers, consolidations, and joint ventures, in a manner similar to its major competitors, and operates in or from nineteen countries around the world including: United States; Canada; United Kingdom; Republic of Ireland; Bermuda; Guatemala; Chile; the Netherlands; Norway; Spain; Kuwait; Algeria; Liberia; Korea; Japan; the Philipines; Indonesia; Sharjah; and Australia. Until 1973, the Company operated in a number of other European, North African, and Middle East countries as well. In addition, company-branded products are marketed in dozens of countries around the world.

As a producer, the Company is a conglomerate with both horizontal and vertical integration in several industries. Altogether, it is involved in various stages of production in at least ten different industries, including:

- oil and gas (exploration, development, production, refining, marketing, and transportation)
- other fuels (synthetic fuels and nuclear fuels)
- petrochemicals
- transportation (marine and pipeline)
- housing construction
- wood products
- television (cable television sports programming)
- insurance (and reinsurance)
- real estate (oil and gas lands, agricultural lands, and office buildings)
- agriculture (citrus, almonds, pistachios, and wine grapes)

Among the Company's $6.3 billion worth of natural and capital property assets are the following (as of December 31, 1981):[1]

Land and Buildings:

1.16 million net acres of producing oil and gas lands; 14.02 million net acres of non-

producing oil and gas lands; 140,000 acres of agricultural and related land; office buildings (owned or leased) in 36 cities in the United States and five foreign countries; and mines and related facilities for uranium and coal.

Minerals:

1.914 billion barrels of net proved oil reserves (1.721 billion barrels developed through 15,637 net wells); 2.824 trillion cubic feet of proved natural gas reserves (2.648 trillion cubic feet developed through 1,893 net wells); 3.776 billion barrels (est.) of non-producing oil shale properties; 832 million barrels (est.) of non-producing diatomite oil properties; unspecified quantities of coal and uranium; and interests in other uranium, gold, copper, molybdenum, and other nonferrous and precious metals.

Refineries and Other Manufacturing Facilities:

4 refineries (3 U.S. and 1 foreign) with combined crude oil capacity of 333,600 barrels per day; and 67 natural gas plants in which the company holds interests.

Storage Facilities

Tank storage for 21 million barrels of crude oil and 19.3 million barrels of products; and underground storage for 3.8 million barrels of natural gas liquids (Kansas and Delaware).

Transportation:

17 marine vessels with combined bulk carrying capacity of 13.17 million barrels; 5,450 miles of crude oil pipelines; 900 miles of natural gas and refined products pipelines; partial interest in an additional 6,241 miles of pipelines; 93 railroad tank cars; 2,247 motor trucks, 294 tractors; 535 trailers; and 1,141 passenger cars.

Marketing Facilities:

170 direct marketing branches for liquid petroleum gas; 297 wholesale distributorships for liquid petroleum gas; 1,184 service stations owned or leased (161 operated by Company); and 26 bulk plants and terminals from which service stations and consumers are supplied.

Financially, the Company is in sound condition. It is currently ranked No. 23 in sales among the "Fortune 500."[2] As of December 31, 1980, it controlled approximately $8.3 billion in total assets. Its short-term and long-term debt appear to be well-managed, with notes payable of $48 million (0.6% of assets), a long-term debt of $605 million (7.3 percent of assets), and an "Aaa" bond rating.[3] Corporate activities yielded a return on average borrowed and invested capital of 16.7 percent in 1981.

Like the other large oil companies, Getty's sales and profits have jumped dramatically over the past decade, as shown in Table 1 below.

TABLE 1

GETTY SALES AND PROFITS
(IN $ BILLIONS)

1971-1981

	Sales	% Change from Preceding Year	Profits	% Change from Preceding Year
1971	1.462	—	0.120	—
1972	1.541	5.4	0.076	-36.7
1973	1.741	13.0	0.135	77.6
1974	2.880	65.4	0.281	108.1
1975	3.125	8.5	0.257	-8.5
1976	3.218	3.0	0.258	0.4
1977	3.478	8.1	0.309	19.8
1978	3.677	5.7	0.328	6.1
1979	4.986	35.6	0.604	83.9
1980	10.321	107.0	0.872	44.4
1981	13.252	28.4	0.857	-1.7

Sources: Standard and Poors Corporation Records, 1981
News Journal Papers

These dramatic increases in sales and profits are largely attributable to the 1973-74 Arab oil embargo (and resultant shortages), the 1979 oil shortage, the 1979 Iranian oil embargo, and the deregulation of gasoline and oil prices, all of which were accompanied by price increases which more than offset the vastly higher prices paid for OPEC-produced oil. It is interesting to note that the two periods of large sales and profit increases during the decade, 1973-74 and 1979-80, have both been followed by sharp contractions. The most recent contraction, still occurring as of Spring, 1982, appears to be squeezing profits more seriously than the 1975-76 contraction did. Along with its major competitors, among which Getty ranks 13th largest, output of refined petroleum products has plummeted during the past year, due to a surplus in the market. This is primarily attributed to a decrease in consumer demand, characterized by the combined effects of negative consumer responses to deregulated prices, conservation efforts, and of the current recession.

ROLE OF THE DELAWARE CITY REFINERY TO GETTY OIL COMPANY OPERATIONS

One of the most significant operations which the Getty Oil Company performs is the refining of crude oil into a number of finished petroleum products, as well as the production of semi-finished products for distribution to other producers. This operation is conducted through the Company's wholly-owned subsidiary, the Getty Refining and Marketing Company. Through this subsidiary, three domestic refineries operate to manufacture the various refined products which are marketed in 32 states and the Philipines, under four brand names.

The Delaware City Refinery is the largest of the three, and until the 1970's, was the only domestic refinery owned by the company since its construction. Initial construction was completed in 1956, and the official opening day ceremonies occurred in May, 1957. Until 1967, when the Tidewater Oil Company was merged under the Getty Oil Company, the refinery was known as the Tidewater Delaware Refinery. It has a crude oil processing capacity of roughly 140,000 barrels per day, one-half of the Company's total current domestic capacity. The other two refineries, located in El Dorado, Kansas, and Bakersfield, California, have crude oil processing capacities of 80,600 and 63,000 barrels per day, respectively. Therefore, it can be concluded that the Delaware City plant is vital to the operations of the Getty Refining and Marketing Co., both because of its capacity to process and refine crude oil, and because of the importance of refining to the marketing of finished petroleum products.

Moreover, the Getty Refining and Marketing Company is vital to the operations of the parent company, Getty Oil Company. From a functional viewpoint, the ability of the Getty Oil Company to refine and market petroleum products is integral to its identity as an oil producer, even though it is conceivably not essential. On balance, the parent company's refining and marketing aspects play a significant role in the sales and profits of the entire operations. In 1981, the company's manufacturing, marketing, and transportation activities, for which the Getty Refining and Marketing Company had the primary responsibility, accounted for sales of $7.22 billion (54 percent of total sales) and profits of $193 million (23 percent ot total profits).[4] Given the importance of the Delaware City Refinery in conducting these activities, it is reasonable to assume that this refinery plays a substantial role in both the sales and profitability aspects of the entire Getty Oil Company. It is also the single most valuable above-ground asset the company owns.[5]

MANUFACTURING ACTIVITIES AND PRODUCTS AT THE DELAWARE CITY REFINERY

Getty's refinery at Delaware City is a vast and complex installation, comprised of more than a dozen different production components and a number of related facilities. Of course, the primary function of the refinery is to process and refine crude oil into a wide variety of finished and semi-finished products. These products are used by other industrial producers and by consumers.

Toward the accomplishment of the overall refining effort, several distinct refinery processes can be identified.[6] They include: separation; conversion; treating; utilities; storage; and transportation. They are described below.

Separation

Separation processes involve the removal of inorganic salts and other impurities

from crude oil and the fractionation (separation) and distillation of crude and partially refined hydrocarbons into distinct groups of hydrocarbons, based on different molecular weights. These processes separate the crude into gases, gasoline, distillate, and residuum.

Conversion

Modern-day demand for refined petroleum products requires a composition of these products which cannot be achieved through separation alone. For instance, crude oil typically contains 25 percent gasoline, which can be isolated by separation from the remainder of the crude. However, current consumer demand requires that each barrel of crude oil be able to yield 43 percent gasoline.[7] Therefore, a portion of the crude oil distillate which remains after separation, must be converted. This is achieved through the use of a technique known as cracking, whereby larger hydrocarbon molecules, such as crude oil distillates, are "cracked" into smaller molecules, such as gasoline and petroleum gases. A variety of specific ways of performing the cracking are used at the Getty refinery and include: hydrocracking; fluid catalytic cracking; fluid coking; alkylation; reforming; and polymerization.[8]

Treating

Treating processes are used to further remove impurities and unwanted compounds from refined petroleum products, thereby improving their quality. Treating is also used to extract asphalt, waxes, and lube oils from oil distillates. A major treatment process at the Getty refinery is desulfurization—the removal of sulfur from kerosene, gasoline, and fuel oil. Four desulfurizers are used for this purpose. Sulfur is then recovered at the sulfur recovery plant, and is subsequently marketed as a by-product. Treating also occurs at the extraction plant, where a solvent is used to separate aromatic hydrocarbons from high-octane gasoline.

Utilities

Utilities are actually a combination of a large number of different processes, but they are organized together because they serve to support the operation of the basic refining processes. The utilities which are organized for this purpose at the Delaware City refinery include:

-River water extraction and distribution

-Groundwater extraction and distribution

-Stream distribution

-Fire protection

-Waste Water treatment

-Emissions control systems

-Caustic handling system

-Solid Waste disposal

-Air distribution

-Other distribution systems

Storage

Crude oil which has been pumped from tankers and barges is stored in giant, floating roof storage tanks prior to being processed. These facilities include eight 200,000-barrel tanks, three 273,000-barrel tanks, and one 400,000-barrel tank.

Refined petroleum products are stored in another set of tanks, prior to shipment. Propane, a liquefied petroleum gas, is stored in a 21 million-gallon underground frozen earth pit. Other facilities are used for the storage of gasoline, jet fuel, kerosene, diesel fuel, and fuel oil.

At the marine terminal, several additional tanks are utilized for the storage of ballast and bilge water which has been unloaded from tankers. This waste water is stored until it is transported to the waste water treatment plant.

Transportation

The transportation process employs pipelines and pumps to move crude oil from the marine terminal, where it is received from tankers and barges, to storage facilities, then to various process units where it is refined into a number of products. Finished products are then transported to storage facilities, and subsequently to trucks, railroad tank cars, or ships at the marine terminal. Pipelines are also used at the refinery for the distribution of water, steam, air, and waste water. Altogether, these various pipelines are dozens of miles long and utilize scores of pumps and thousands of valves.

DEVELOPMENT AND EXPANSION AT THE DELAWARE CITY REFINERY

When the Getty refinery was initially constructed at Delaware City between 1955 and 1957, it cost approximately $200 million. At the time, it was the largest refinery to have been constructed at one time.

While improvements have been made at the facility on a continual basis since that time, the period of greatest development and expansion has occurred since 1971. For instance, between 1971 and 1978, the company sought coastal zone permit status decisions from the Delaware Office of Management, Budget, and Planning (formerly called the State Planning Office) for twelve construction or improvements projects.[9] Since 1978, seven additional projects, valued at approximately $403 million, have been initiated or authorized. Of these nineteen projects which have been undertaken since 1971, seven have been primarily or exclusively for the purpose of pollution control. In other cases, pollution control equipment has been modernized as part of the project. All construction or improvement projects since 1971 are listed in Table 2 below, including approximate costs where known.[10]

TABLE 2

EXPANSION AND IMPROVEMENTS PROJECTS
GETTY DELAWARE CITY REFINERY
1971-84

Year	Project
1971	Carbon monoxide boiler
1971	Merox treatment plant
1972	Beavon-Stretford process plant
1972	Activated sludge waste water treatment facility ($3.4 million)
1973	Catalytic cracking unit modifications
1974	Turbogenerator installation
1976	Reformer modification
1977	Aromatics recovery project (equipment, tanks, recovery tower)
1977	Wellman Lord stack gas scrubber ($92 million)
1978	Fractionation tower improvements to produce toluene ($5.2 million)
1978	Storage tank construction
1978-80	Waste water expansion project ($29 million)
1978-80	Sour water stripping facility ($17 million)
1980-82	Methanol plant construction ($110 million)
1980-82	Low pressure reformer construction ($140 million)
1980-82	Sulfur recovery plant ($30 million)
1983-84	Fluid coker modifications and crude distillation unit modifications (combined cost = $57 million)

Sources: Delaware Coastal Management Program
Getty Oil Company Annual Reports
News Journal Papers

CHAPTER NOTES

1 Standard and Poors Corporation Records (1981), pp. 8915-8916.

2 "Fortune's Directory of the 500 Largest Industrial Corporations," Fortune Magazine (May 3, 1982), pp. 258-286.

3 Moody's Industrial Manual (1981), p. 3077.

4 Getty Oil Company, 1980 Annual Report.

5 Interview with Ray Arzinger, Vice President and Plant Manager (May 28, 1982).

6 Gregg Kerlin and Daniel Rabovsky, Cracking Down: Oil Refining and Pollution Control (Council on Economic Priorities, 1975), pp. 67-80.

7 American Petroleum Institute, Basic Petroleum Data Book — Petroleum Industry Statistics (Vol, 1, No.3, September 1981).

8 Getty Refining and Marketing Company, Refinery Tour, pp. 5-8.

9 Delaware OMBP, "Coastal Zone Act Administration," Delaware Coastal Management Program and Draft Environmental Impact Statement (1979), Appendix I, pp. 86-134.

10 Getty Oil Company, Annual Report (1975-81).

11 Wilmington Morning News (September 1982).

PART II

COASTAL ENERGY ACTIVITY IMPACT ANALYSIS

CHAPTER 3

OVERVIEW OF THE ANALYSIS

The Coastal Energy Activity Impact Analysis for Delaware City has been developed to examine how an existing coastal energy activity, the Getty refinery, has affected life in the neighboring community over the years that it has operated. This analysis, which is an extensive and far-reaching examination of the refinery's operations vis-a-vis their effect on the community, has been conducted with an important underlying assumption: the Getty refinery has existed for many years and will most likely continue to exist for many years to come, as an established and viable industrial installation. Moreover, its existence can be regarded as valuable to national, regional, and local interests relative to the need for a dependable source of energy-producing resources. However, there are other interests which are also vital to the nation, the region, and the local area, such as the interests associated with healthy air and water resources, which satisfy the important needs of safe breathing, drinking, and recreation. These interests must be balanced, so that additional interests, such as abundant employment and other economic opportunities, can be achieved at an acceptable cost to society.

In accordance with the general framework as stated above, it is not the purpose of this study to determine whether, overall, the refinery has been more of an asset or more of a liability to the people of Delaware City—the issue is just not that simple. Rather, the purpose is to identify significant problems, as well as significant opportunities, facing the community as a result of the presence of the refinery. On this basis, the recommendations which follow the analysis have been developed to suggest strategies for Delaware City to minimize or reduce the problems and enhance the opportunities.

The analysis will proceed by first examining the five types of physical impacts identified in Chapter 1, followed by the seven types of social and economic impacts. Recommendations are presented at the end of each chapter which has involved the analysis of a specific set of impacts affecting life in the community. These recommendations are also summarized at the end of the report.

By necessity, the conduct of the analysis which follows has required that Delaware City be the key reference in discussing the various impacts of Getty operations. It should be pointed out that "Delaware City" refers to several interrelated but distinct things—it refers to the people who reside within a particular geographical area, while it also refers to a shared set of values, concerns, needs, and heritage. In addition, it refers to the geographical boundaries themselves and to the governmental unit which has jurisdiction within these boundaries. In various places in the report, "Delaware City" is sometimes referred to as a town, while other times it is referred to as a city. There is a reason for this differentiation and it is explained as follows:

- "Delaware City" is a town when discussing the community in general, its people, its features, and characteristics.

- "Delaware City" is a city when discussing events involving the incorporated government, its officers, official actions, and publicly-owned properties.

At the same time, the Getty refinery at Delaware City has been the key reference in discussing various actions and events which have been the source of many impacts upon Delaware City. At different times reference is made to "the refinery," "the company," "Getty," as well as the formal names of the firm which operates the refinery, the "Getty Oil Company," and its subsidiary, the "Getty Refining and Marketing Company." These various names are used to discuss both the firm which operates the refinery and also the physical plant of the refinery itself. With respect to the role of the refinery in these analyses, it was decided that the entire facility, both the portion which lies within the municipal boundaries and the portion in the adjacent unincorporated New

Castle County, must be treated as a unified whole, since operations throughout the facility may result in impacts upon the community. However, in certain instances, only the portion of the refinery within the incorporated area of Delaware City is used as the reference, particularly for the discussion of property taxation issues.

A. PHYSICAL IMPACTS

CHAPTER 4

SHORELINE EROSION AND FLOOD HAZARD IMPACT ANALYSIS

SHORELINE EROSION IMPACTS

The shoreline of the Delaware River in the vicinity of Delaware City consists typically of marsh set against a high, but narrow, coastal plain. The development of sandy barriers and beaches is generally precluded due to the low wave energy and the lack of a sufficient sand supply. In addition, the limited width of the Delaware River at this location does not allow large waves to form, thereby limiting shoreline erosion.[1]

The only area subject to erosion near Delaware City is the approximately 200 feet of sandy beach at the foot of Washington Street known as "Baby Beach" (See Figure 1). Examination of historical shoreline records, however, does not indicate that erosion has occurred in this area.

During site visits to this area, docking and departing oil tankers were observed. No waves of any significance were noted reaching shore from these vessels. If shoreline erosion is occurring in this area, it is probably caused by the natural current and wave action of storms, rather than by the marine traffic.

A more typical situation in this part of the Delaware River is the rapid buildup of fluvial deposits on top of compacted older geological sedimentary formations. The deposited muds vary in thickness from 0 to 10 feet in the vicinity of Delaware City.[2] As a result of these sediments, frequent (every two years) dredging is required to keep Getty's shipping channel open.

Comparison of aerial photographs taken in 1954 with those taken in 1982 indicate that the shoreline along the Getty piers has accrued rather than eroded deposits.

FLOOD HAZARD IMPACTS

Flood History

The following flood history for Delaware City and the Delaware River vicinity was obtained from the U.S. Army Corps of Engineers Reconnaissance Report - Tidal Flood Problem - Delaware City (May 1975).

August, 1933

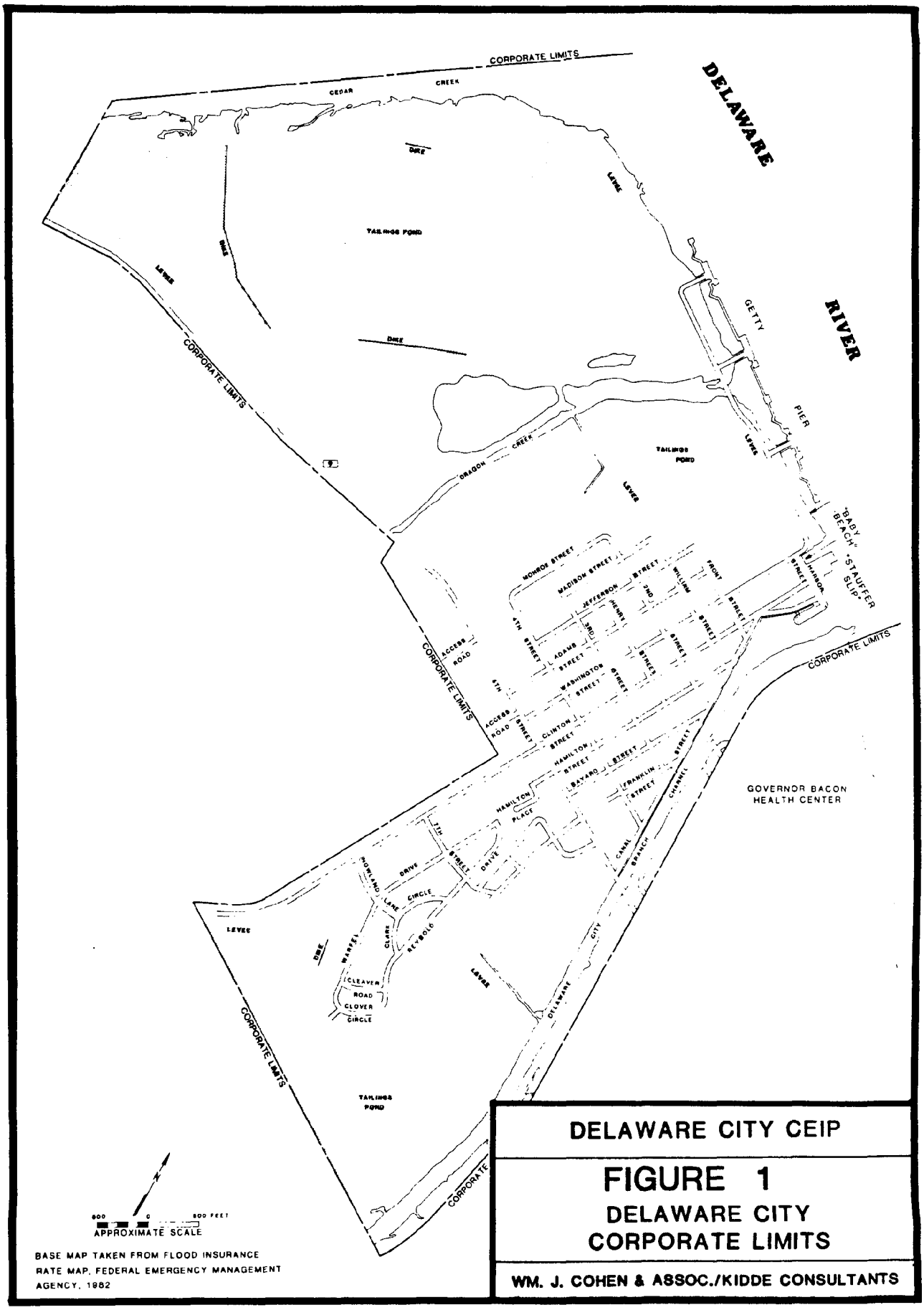
The hurricane of 1933 produced a tidal elevation of +8.8 feet and winds up to 75 miles per hour in Philadelphia. (Apparently, no data was recorded specifically for Delaware City.)

September, 1944

The greatest flood recalled by city officials occurred during this storm. Water from this "northeaster" advanced nearly two blocks into the city.

November 24-27, 1950

This storm produced high winds and heavy precipitation in the New Jersey-Delaware area. New Castle County Airport recorded gusts up to 70 mph. A tidal elevation of +8.5 feet was recorded at Delaware City. This elevation represents the highest tide recorded at Delaware City.



DELAWARE CITY CEIP

FIGURE 1

DELAWARE CITY CORPORATE LIMITS

WM. J. COHEN & ASSOC./KIDDE CONSULTANTS

August, 1955

Hurricanes "Connie" and "Diane" produced a high tide of +5.6 feet (recorded at New Castle).

March 6-8, 1962

This storm produced a maximum tidal elevation of +7.5 feet at Reedy Point (which is the entrance to the C and D Canal) and +7.2 feet at Philadelphia. The storm lasted approximately 60 hours, which is an unusually long duration, and produced five consecutive abnormally high tides.

December 1-2, 1974

The Delaware Geological Survey reports that maximum water levels were only 1 to 3 feet below peak tidal levels reached during the March 1962 storm. The damage from this "northeaster" was considerably less than the one in 1962, however, because of its shorter duration (two to three tidal cycles).

Identification and Analysis of Flood Hazards

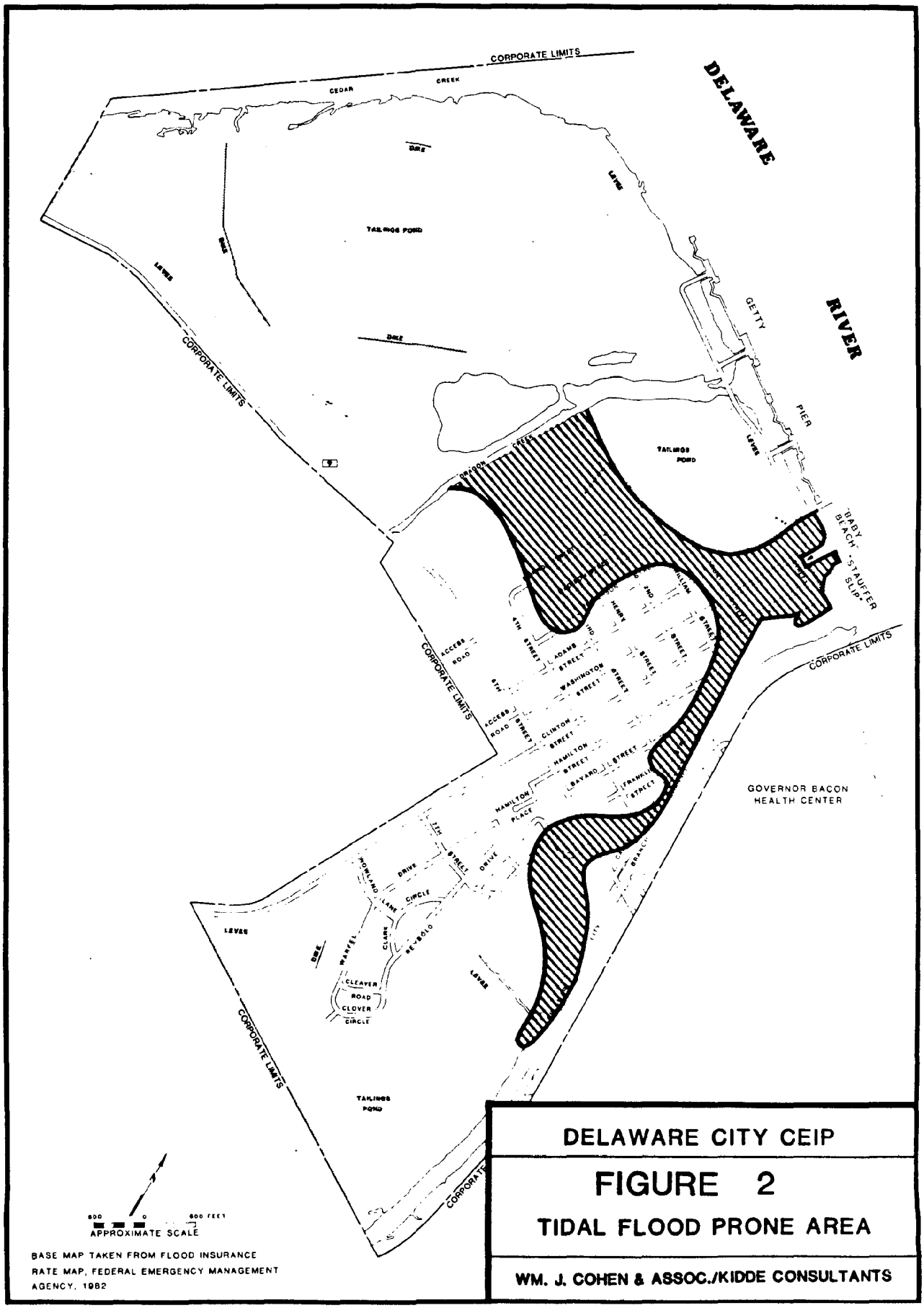
Information from various published sources indicates that the eastern end of Delaware City is frequently inundated.[3, 4] The flooding is due, primarily, to the high tides from storm surges, coupled with wind driven waves. Strong storms blowing out of the northeast tend to produce the more severe flooding problems.

Delaware City is located, for the most part, in the Delaware River's floodplain. The topography is essentially flat, with the highest elevation at +20 feet (Nowland Lane at Clinton Street). The normal high tide is at +5.5 feet, which is only below 0.3 feet below the elevation of William Street. Studies conducted by the Corps of Engineers indicate that the stillwater base flood elevation (i.e., 100-year) is 9 feet. This means that a 100-year frequency storm would flood Delaware City up to elevation +9. Figure 2 shows the zone that would be flooded by a 100-year storm.

Under these conditions, most of the central business district would be inundated, along with most of Canal Street and the residential sections of Monroe and Madison Streets. From a visual inspection, it is apparent that most of the tidal encroachment enters the main part of the city at two locations: at the foot of Washington Street near Harbor Street and along the old canal.

In 1976, bulkheading was constructed as a part of improvements to Fort Delaware State Park. This concrete capped, steel sheet pile bulkhead bounds much of the park from a point near Washington and Harbor Streets to a point opposite the intersection of Canal and Clinton Streets, where it meets the older bulkheading along the Canal (See Plate 1, in Appendix A). The newer bulkheading was constructed at elevation +9 feet, while the older section was constructed without the concrete capping, at approximate elevation +7. Approximately 350 feet of the park's shoreline is not bulkheaded. The area south of the park's main building is protected with riprap up to elevation +7.

Washington Street was extended northeast from Harbor Street to provide an access into the Getty property to the west. A small cove or shallow sloping slip, covered with slagstone and approximately 100 ft. wide, lies to the north of Harbor Street and between the bulkhead and the line of the southeast side of Washington Street extended. Part of this area is owned by Stauffer Chemical Company and is known as the "Stauffer



BASE MAP TAKEN FROM FLOOD INSURANCE RATE MAP, FEDERAL EMERGENCY MANAGEMENT AGENCY, 1982

DELAWARE CITY CEIP

FIGURE 2

TIDAL FLOOD PRONE AREA

WM. J. COHEN & ASSOC./KIDDE CONSULTANTS

slip". From the point where the entrance road turns into the Getty property, large chunks of broken reinforced concrete and concrete filled caissons have been dumped along the bank of the beach, apparently to retard shoreline erosion.

Washington Street falls to the southwest from the Getty entrance to a low area 300 to 400 feet from Harbor Street. Ground to the northwest of Washington Street has a general rise to the levee of the Getty property. The approximate drainage area is bounded on the east by Clinton Street; on the southwest by Second Street; and on the west by the Getty spoils disposal area. This constitutes an area of approximately 18 acres.

The outfall of this watershed lies along the southeast side of Washington Street. A small grate inlet is situated adjacent to the road at the southwest lot line of a building fronting on Clinton Street. The outfall of this inlet is a 15 in. concrete pipe having a shallow cover under the entrance to the rear of the lot, extending along Washington Street almost the full width of the lot and emptying into a side ditch. The ditch continues along the roadway to a headwall near the corner of Washington and Harbor Streets. The culvert entrance is covered by chain link fencing fabric, probably to prevent children or pets from entering. A 24 in. steel pipe conveys the flows from the ditch to a reinforced concrete box with approximate inside dimensions of 5 ft. square by 4 ft. deep. A cast iron flap gate is affixed to the 24 in. pipe where it enters the box. The box has a steel plate cover and is connected by a 24 in. pipe passing under Harbor Street to a similar box opposite the Getty entrance. A flap gate is also hung on this pipe at its entrance into the box. This box has a bar grate cover. The box outfall is toward the river, but its terminus could not be located and is apparently under water offshore (See Plate 2, in Appendix A).

The effectiveness of the storm drain system described above is highly questionable. The 15" pipe outfall of the inlet in the sump is choked with silt to about 3/4 of the pipe depth. The surface of standing water in the inlet was just a few inches below the grate. Standing water was noted at the headwater entrance to the outfall system at Harbor Street as well as in both flap gate boxes. The depth of standing water in the downstream box was greater than that in the upstream box by as much as perhaps 1.5 ft. Standing water in the downstream box indicates blockage in the outfall pipe to the river.

The effectiveness of the tidal flood control system is also highly questionable. The low area along Washington Street floods under normal high tides due to the malfunctioning of the flap gates. These gates fail to perform their function because (1) they are inappropriate for the intended use and (2) debris prevents the complete sealing of the gates allowing the tide to back up through the system.

ENGINEERING RECOMMENDATIONS

Shoreline Erosion

In order to interrupt longshore sand movement in the Baby Beach area, it is recommended that the existing, poorly defined groin be enhanced with new stone riprap. An improved groin in this area would contribute to the accumulation of sand in this area as well as improving the aesthetics of the area.

The new riprap should be hard, durable stone; angular in shape; resistant to weathering and to water action; free from overburden, spoil, shale, slate and organic material. At least 60% of the pieces should weigh 100 pounds or more (See Section 733, Delaware Department of Highways and Transportation Standard Specifications).

The area to be improved with riprap measures approximately 25 feet by 100 feet (See Plate 1). The average depth should be approximately 4 feet. The estimated in-place cost for this work is $34,000.

Flood Hazards

Most of the flood hazards in Delaware City can be reduced by minimizing the effects of tidal action and storm surges. Very little flooding occurs from actual stormwater buildup. The engineering recommendations amount therefore, to bringing the waterfront area up to an elevation above the frequent tidal and storm surges. The following recommendations are offered:

1. The "Stauffer slip" area should be bulkheaded and backfilled to elevation +9 from the existing bulkhead to the higher ground of the Getty property. (See Plate 1). The portion of the bulkhead paralleling Harbor Street should be constructed just east of the Stauffer Chemical Company property line.

   Most of the new bulkhead should have a design similar to that of the existing Fort Delaware Park bulkhead (See Figure 3). The new bulkhead extending behind the Baby Beach area should be constructed of concrete and should have a removable section in order to accomodate the occasional use of this area by Getty to beach heavy equipment (See Figure 4). The concept plan on Plate 1 assumes that this removable section of bulkhead will be 40 feet wide; however this can be changed during final design to suit the needs of Getty.

   It should also be noted that the proposed bulkhead across the "Stauffer slip" should not preclude future use of the slip by Stauffer Chemical. If this area is to be used as a mooring for vessels, however, dolphins of adequate size will have to be constructed. Neither the proposed bulkhead nor the existing bulkhead can withstand the pressures exerted by a moored vessel.

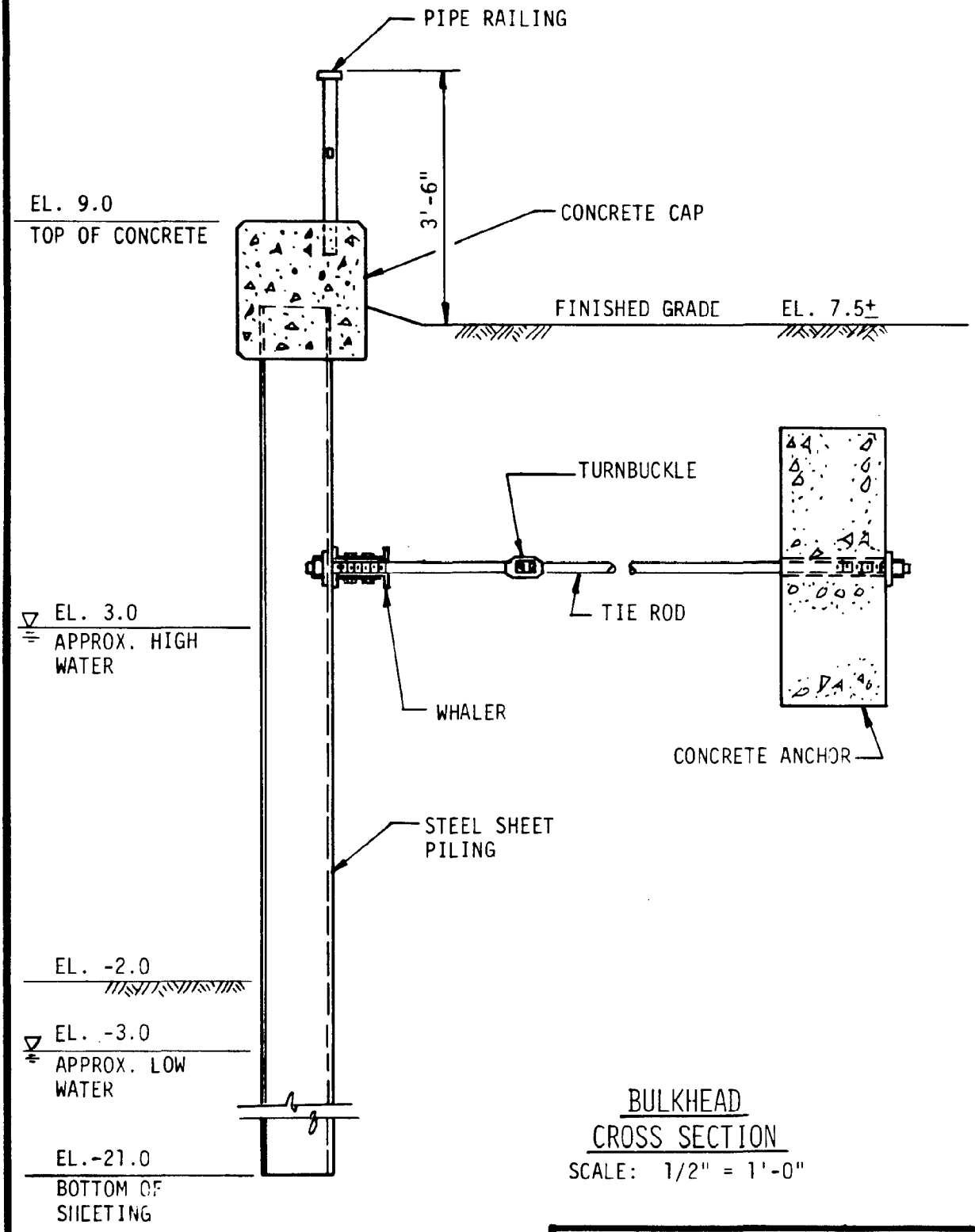
2. The existing riprap dike just south of the Fort Delaware Park building should be increased to elevation +9 feet (See Figure 5). The riprap should be similar in quality to that specified for the groin improvements.

3. The existing bulkhead (elev. +7) along the Canal should be fitted with a 2 foot concrete cap, similar to that used for the Park's bulkhead (See Figure 6). In addition, a completely new section of bulkhead should be constructed along the Canal from William Street to Fourth Street. The existing boat ramp near William Street should be relocated beyond the terminus of the proposed bulkhead.

   The estimated cost of constructing the tidal flood protection structures is as follows:

   Stage I

1. Bulkhead the "Stauffer slip" area	
225 L.F. of new steel sheet pile with cap and rail	$127,800
60 L.F. concrete retaining wall on beach	11,000
40 L.F. removable concrete wall	11,000
Backfill and earthwork	25,100
TOTAL STAGE I	$174,900



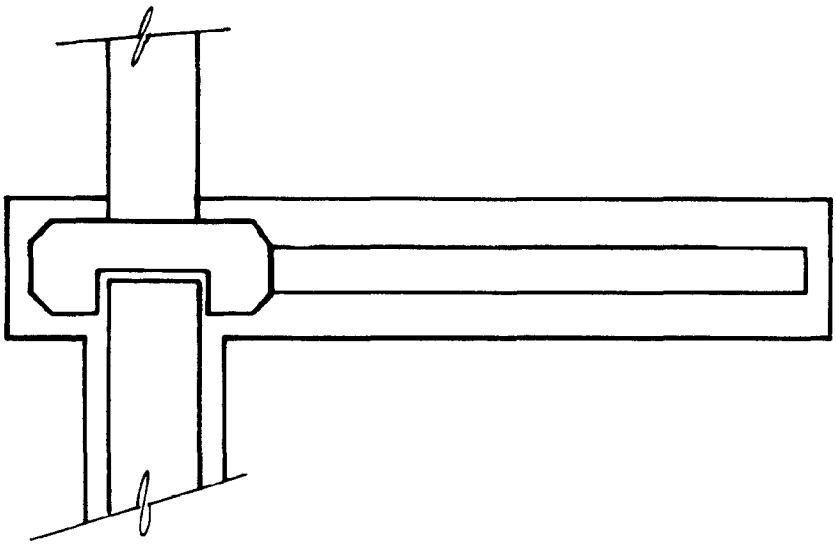
BULKHEAD
CROSS SECTION
SCALE: 1/2" = 1'-0"

DELAWARE CITY CEIP

FIGURE 3

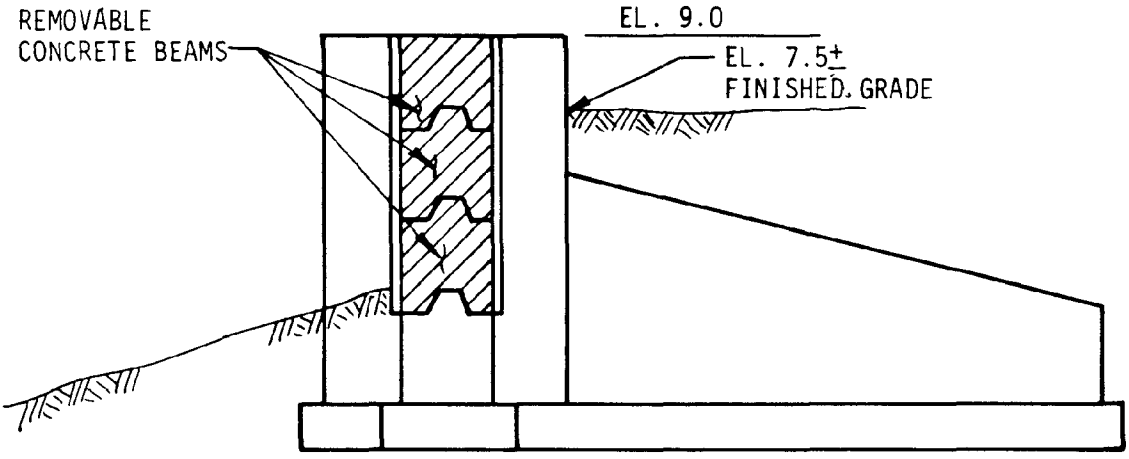
STEEL SHEET PILING COMPLETE NEW CONSTRUCTION

WM. J. COHEN & ASSOC./KIDDE CONSULTANTS



PLAN

SCALE: 1/4" = 1'-0"



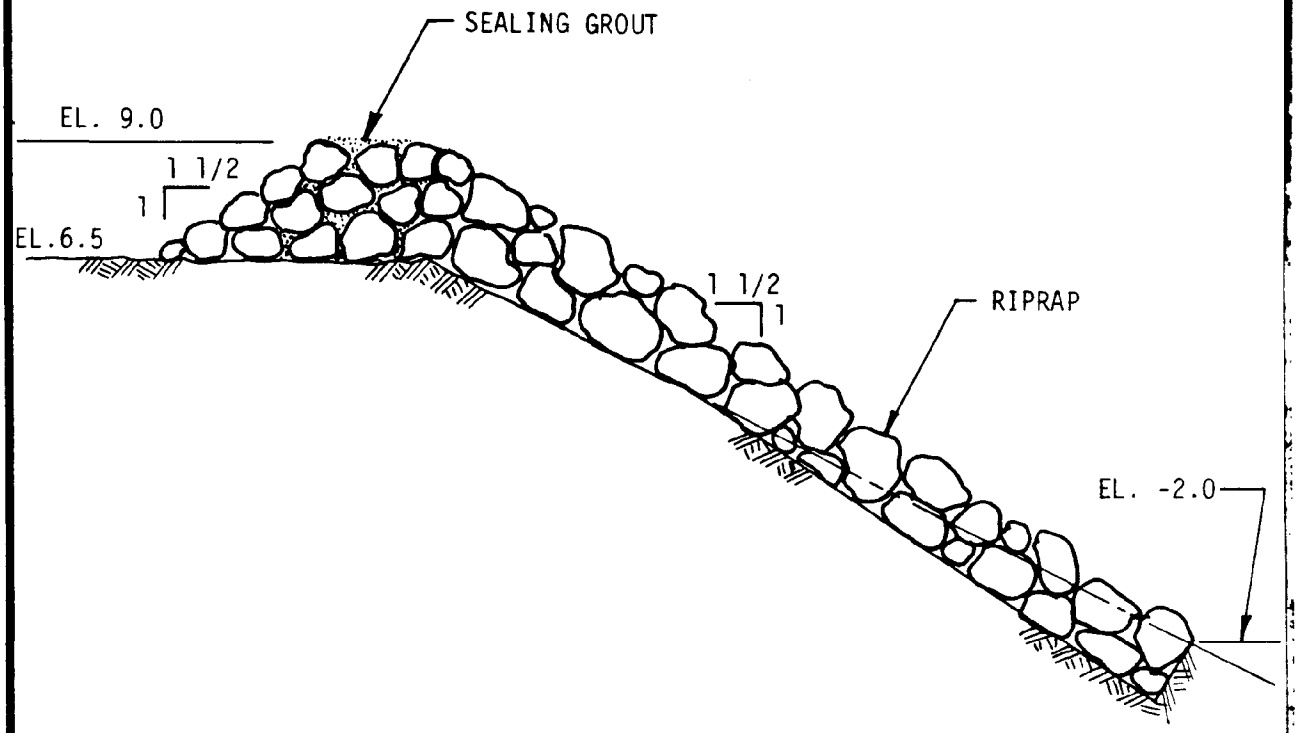
ELEVATION

SCALE: 1/4" = 1'-0"

DELAWARE CITY CEIP

FIGURE 4
REMOVABLE CONCRETE BULKHEAD

WM. J. COHEN & ASSOC./KIDDE CONSULTANTS



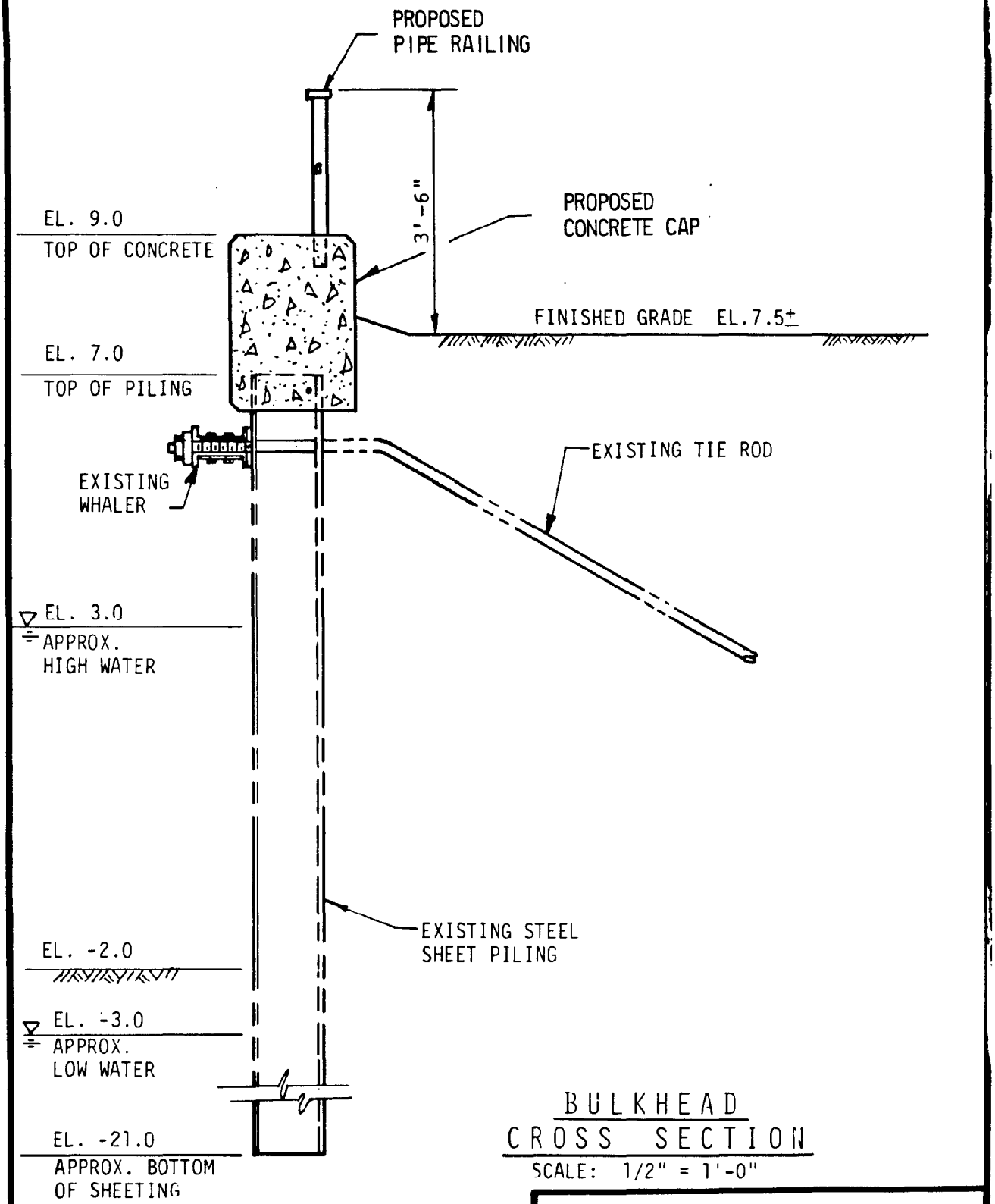
RIPRAP
CROSS SECTION
SCALE: 1/4" = 1'-0"

DELAWARE CITY CEIP

FIGURE 5

DIKE ENHANCEMENT

WM. J. COHEN & ASSOC./KIDDE CONSULTANTS



BULKHEAD
CROSS SECTION
SCALE: 1/2" = 1'-0"

DELAWARE CITY CEIP

FIGURE 6

PROPOSED CONCRETE CAP ADDED TO EXISTING SHEET PILING

WM. J. COHEN & ASSOC./KIDDE CONSULTANTS

Stage II

1.	Increase riprap dike near State Park Building to elevation +9 30 ft. x 300 ft. x 40 ft. riprap	$59,600
2.	Add concrete cap to existing canal bulkhead 810 L.F. $91,000	
3.	Construct new bulkhead along canal to Fourth Street	
	1230 L.F. new steel sheet pile w/acc.	$698,300
	Backfill and earthwork	21,000
	Subtotal	$719,300
	TOTAL STAGE II	$869,900
	Grand total for all tidal flood protection structures (Stages I and II)	**$1,044,800**

Implementation of Stage I would protect the City from the stillwater tidal flooding associated with a 10-year storm. Stage II would protect up to a 100-year storm.

In addition to increasing the elevation of the waterfront area, it will also be necessary to perform some work on the drainage system along Washington Street. Not only must this system be altered to meet the new bulkhead configuration, but it must also be improved to prevent tidal water encroachment.

The 100-year storm hydrograph developed for the Washington Street low area is shown in Figure 7. As this hydrograph indicates, the peak eight hours of the storm would produce some 140,000 cubic feet of water. If the flap gates are closed, there is enough natural stormwater retention in the Washington Street sumped area to avoid flooding any existing structures (See Figure 8).

In order to ensure that tidal action no longer encroaches into the stormwater system, the following improvements should also be made:

1. Remove existing flap gate located in the junction box west of Harbor Street.

2. Plug the existing flap gate in the junction box located adjacent to the "Stauffer slip".

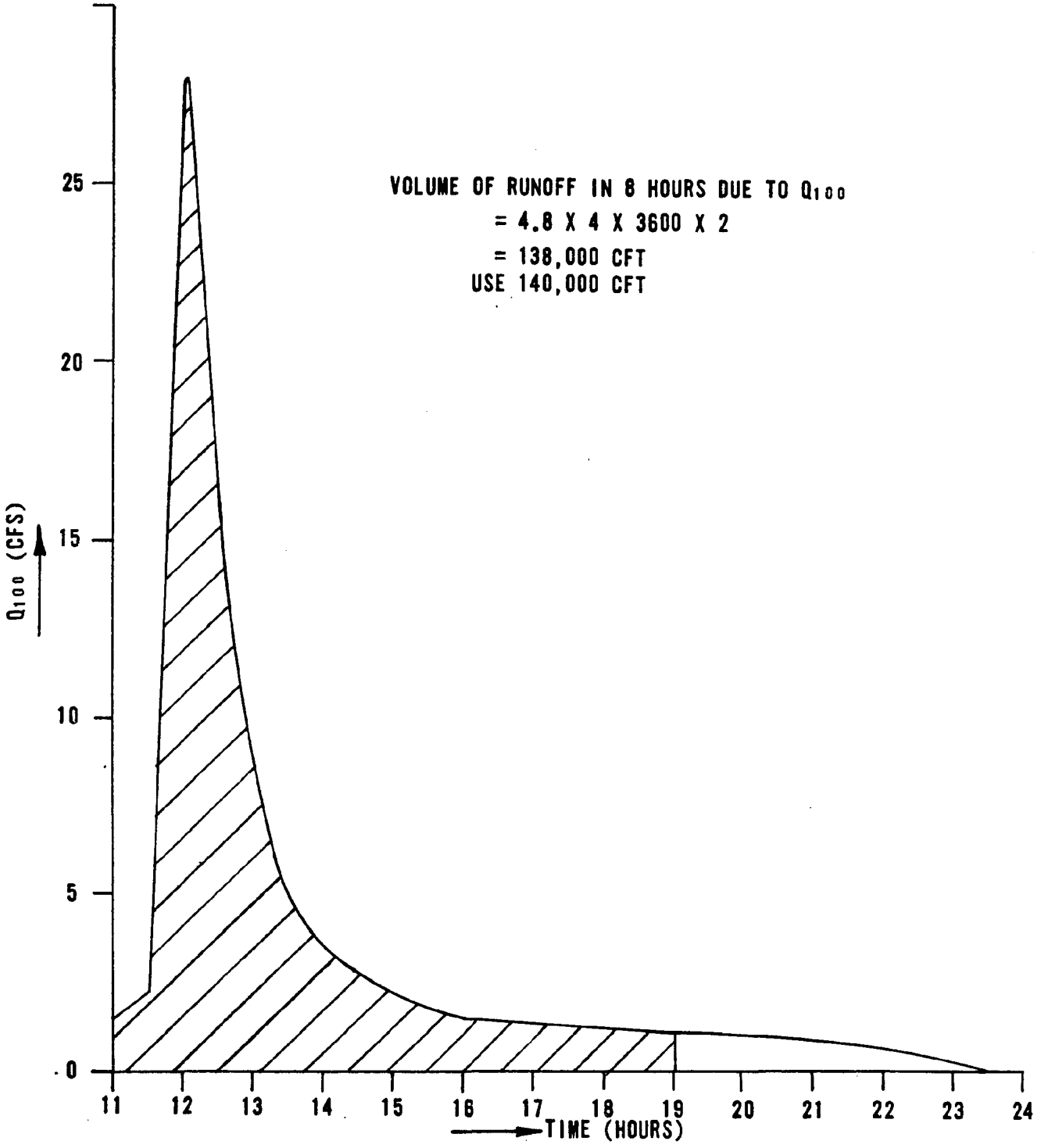
3. Construct a new outlet system from the existing junction box to the proposed bulkhead. This would include two new flap gates, a new junction box and 75 L.F. of 24-inch metal pipe. The new flap gates should be slant type gates.

The estimated cost of rehabilitating the drainage system is $10,000.

KIDDE CONSULTANTS, INC.
Subsidiary of Kidde, Inc.

1020 CROMWELL BRIDGE ROAD, BALTIMORE, MARYLAND 21204
300 EAST JOPPA ROAD, BALTIMORE, MARYLAND 21204
1385 PICCARD DRIVE, ROCKVILLE, MARYLAND 20850
518 EAST CHARLES STREET, LA PLATA, MARYLAND 20646
SUITE 103, UNIVERSITY OFFICE PLAZA, NEWARK, DELAWARE 19702

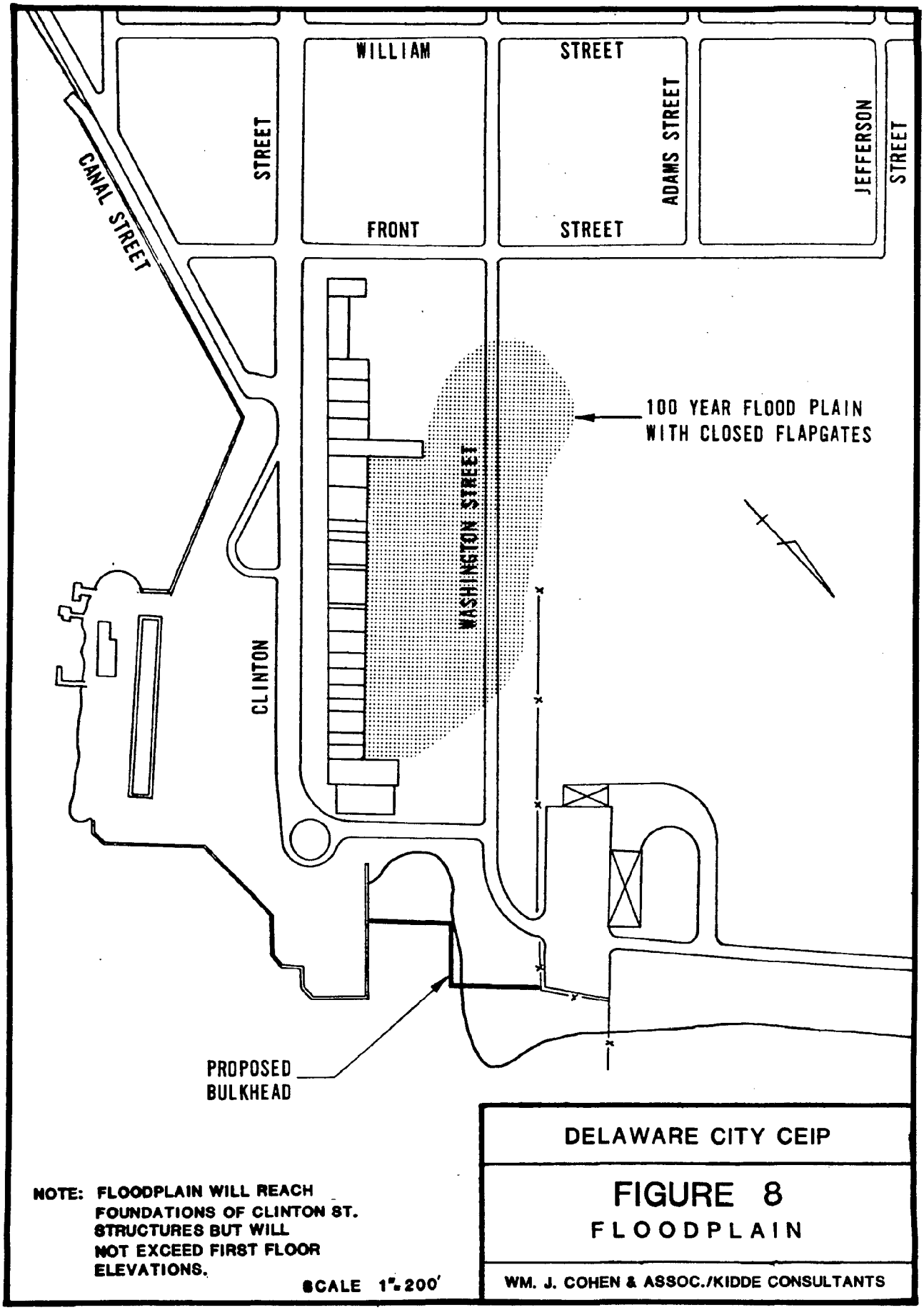
DESIGN JKD DATE 8/26/82 SUBJECT DELAWARE CITY FLOOD STUDY J.O. 01-81271
CHECK DATE SHEET OF



DELAWARE CITY CEIP

FIGURE 7
100 YEAR HYDROGRAPH

WM. J. COHEN & ASSOC./KIDDE CONSULTANTS



NOTE: FLOODPLAIN WILL REACH FOUNDATIONS OF CLINTON ST. STRUCTURES BUT WILL NOT EXCEED FIRST FLOOR ELEVATIONS.

SCALE 1"=200'

DELAWARE CITY CEIP

FIGURE 8
FLOODPLAIN

WM. J. COHEN & ASSOC./KIDDE CONSULTANTS

CHAPTER NOTES

1 Delaware Coastal Zone Management Program, Delaware's Changing Shoreline, Technical Report No. 1, May 1976.

2 Ibid.

3 Federal Insurance Administration, Flood Insurance Study - City of Delaware City, August 1976.

4 Federal Emergency Management Agency, Flood Insurance Study - Wave Height Analysis - City of Delaware City, March 1982.

CHAPTER 5

AIR QUALITY IMPACT ANALYSIS

ANALYSIS OF GETTY AIR EMISSIONS

Types of Refinery Emissions

As refineries distill crude oil into petroleum products, they also emit a variety of airborne by-products. Some of these substances are known to be harmful to human health if they are released at high ambient concentrations. In spite of costly, high technology measures to control these emissions, significant levels of air pollutants are often emitted during the refining process.

The Environmental Protection Agency (EPA) currently regulates six major classes of air pollutants: suspended particulates, sulfur oxides (SOx), carbon monoxide (CO), nitrogen oxides (NOx), hydrocarbons (HC), and photochemical oxidants (Smog). These pollutants were selected for regulating because (1) their effect on human health is known and (2) they are easily measured. Refineries directly emit all these pollutants, except smog. (Smog is produced, however, when NOx reacts with sunlight and the atmosphere).

Suspended particulates are small (less than 10 microns) solid or liquid particles that are suspended in and carried by the atmosphere. The refining process produces a non-combustible ash particulate. This ash is often comprised of metallic oxides, sulfates and chlorides. Some of the metals, including vanadium and nickel, are known to be poisonous at high concentrations. Suspended particulates less than 2 microns in size can be especially harmful to humans because they can penetrate deep into the sensitive regions of the lungs.

Sulfur oxides are, perhaps, the most ubiquitous air pollutant emitted by refineries. The Delaware City Getty Plant has a particularly tough problem with sulfur oxides since it refines the high-sulfur Middle East crude. SOx can be harmful to humans when it combines with the moisture in the air to form sulfuric acid mists. There is evidence that these substances can aggravate chronic lung diseases. SOx, and its products, can also corrode metals and dissolve stone and can cause harm to agricultural products.

Carbon Monoxide is a colorless, odorless, poison gas produced by the incomplete burning of carbon in fuels. CO replaces oxygen in the red blood cells, thus reducing the amount of oxygen that can reach the body cells and maintain life. Catalytic crackers and improperly controlled combustion account for most of the CO emitted by the refining process. Refineries, however, are usually considered minor sources of CO when compared to automobiles.

Nitrogen oxides are poisonous and highly reactive gases that are produced when fuel is burned at high temperatures, causing some of the abundant nitrogen in the air to burn also. NOx irritates the lungs and lowers the body's resistance to respiratory infections. Its principal harm, however, comes from the smog it helps create be reacting in sunlit air with hydrocarbons.

Hydrocarbons are gases that are produced from incomplete combustion and from evaporation of petroleum products. Most hydrocarbons are not hazardous to human health; however, they can combine with NOx and sunlight to produce smog.

Photochemical oxidants, or smog, is a poisonous form of oxygen that irritates the mucous membranes of the breathing system causing coughing, choking, and impaired lung function. The production of smog requires ultraviolet sunlight, NOx, and reactive hydrocarbons — all of which are present in the refining process.

Air Quality Standards and Regulations

The air quality standards and regulations for the State of Delaware are contained in Regulations Governing the Control of Air Pollution (DNREC, February 1, 1981). The ambient air quality standards for the six major pollutants are summarized in Table 3.

Other applicable sections of the DNREC regulations include:

- Regulation No. V, Particulate Emissions from Industrial Process Operations, especially Table 3 (Allowable Mass Emission Rate from Catalytic Cracking Operations) and Table 4 (Allowable Mass Emission Rate from Fluid Coking Operations).
- Regulation No. VI, Particulate Emissions from Construction and Materials Handling, especially Section 6 - Material Storage (See Appendix B).
- Regulation No. IX, Emissions of Sulfur Compounds from Industrial Operations, especially Section 3 - Restriction on Sulfur Recovery Operations.
- Regulation No. XI, Carbon Monoxide Emissions from Industrial Process Operation, New Castle County.
- Regulation No. XIV, Visible Emissions.
- Regulation No. XIX, Control of Odorous Air Contaminants.
- Regulation No. XX, New Source Performance Standards.
- Regulation No. XXIV, Control of Volatile Organic Compound Emissions, especially Section 14 - Petroleum Refinery Component Leaks.

TABLE 3

AMBIENT AIR QUALITY STANDARDS

Pollutant	Primary	Secondary
Particulate Matter		
Annual geometric Mean	75	60
Maximum 24-hour	260	150
Sulfur Oxides		
Annual Arithmetic Mean	80 (0.03 ppm)	
Maximum 24-hour Concentration	365 (0.14 ppm)	
Maximum 3-hour Concentration		1300 (0.5 ppm)
Carbon Monoxide		
Maximum 8-hour Concentration	10,000 (9 ppm)	same as
Maximum 1-hour Concentration	40,000 (35 ppm)	primary
Photochemical Oxidants		
Maximum 1-hour Concentration	235 (0.12 ppm)	same as primary
Hydrocarbons		
Maximum 3-hour Concentration	160 (0.24 ppm) (6-9 am)	same as primary
Nitrogen Oxides		
Annual Arithmetic Mean	100 (0.05 ppm)	same as primary

* hydrocarbons exclude methane.

Note: All standards are expressed as micrograms per cubic meter. The standards for gaseous pollutants are also expressed in parts per million (ppm). Maximum concentrations are not to be exceeded more than once each year.

Historical Trend Analysis of Monthly Air Quality Reports

The DNREC, Air Resources Section, continuously monitors the quality of the air throughout Delaware. The Air Resources Section has a network of 16 air quality monitoring stations throughout the State (See Figure 9). The pollutants monitored include nitrogen dioxide, suspended particulates, sulfur dioxide, carbon monoxide, rainfall acidity, ozone, lead, and radiation dose. Not all pollutants are monitored at all stations, however. The air quality monitoring station located nearest Delaware City is Station S-8, which is located on the grounds of the Governor Bacon Health Center (See Figure 10). Station S-8 monitors only suspended particulates and sulfur dioxide and does not monitor ozone, acidity, carbon monoxide, nitrogen dioxide, lead or radiation. The geographic location of the station, however, is extemely advantageous since it is situated in the same horizontal plane with the Getty Plant and the City of Delaware City.

Getty also owns and operates four air quality monitoring stations in the vicinity of the refinery. These stations were installed voluntarily by Getty in order to provide enough monitoring data for their Prevention of Significant Deterioration (PSD) permit. These stations were not installed as a result of any air quality incidents. The stations send telemetered signals to the Getty office and measure particulates, SO_2, ozone and hydrocarbons. All emission records are sent to the Air Resources Section and are available for review; however, no monthly or annual summaries are made.

The monthly air quality data, as collected by the DNREC, was examined for the period January, 1976 through March, 1982. Figure 11 is a plot of the twelve month arithmetic averages of the sulfur dioxide levels, expressed in parts per million (ppm). Figure 12 is a plot of the annual geometric means of suspended particulate, expressed in micrograms per cubic meter (ug/m^3). The ambient air quality standards are also indicated on these two figures.

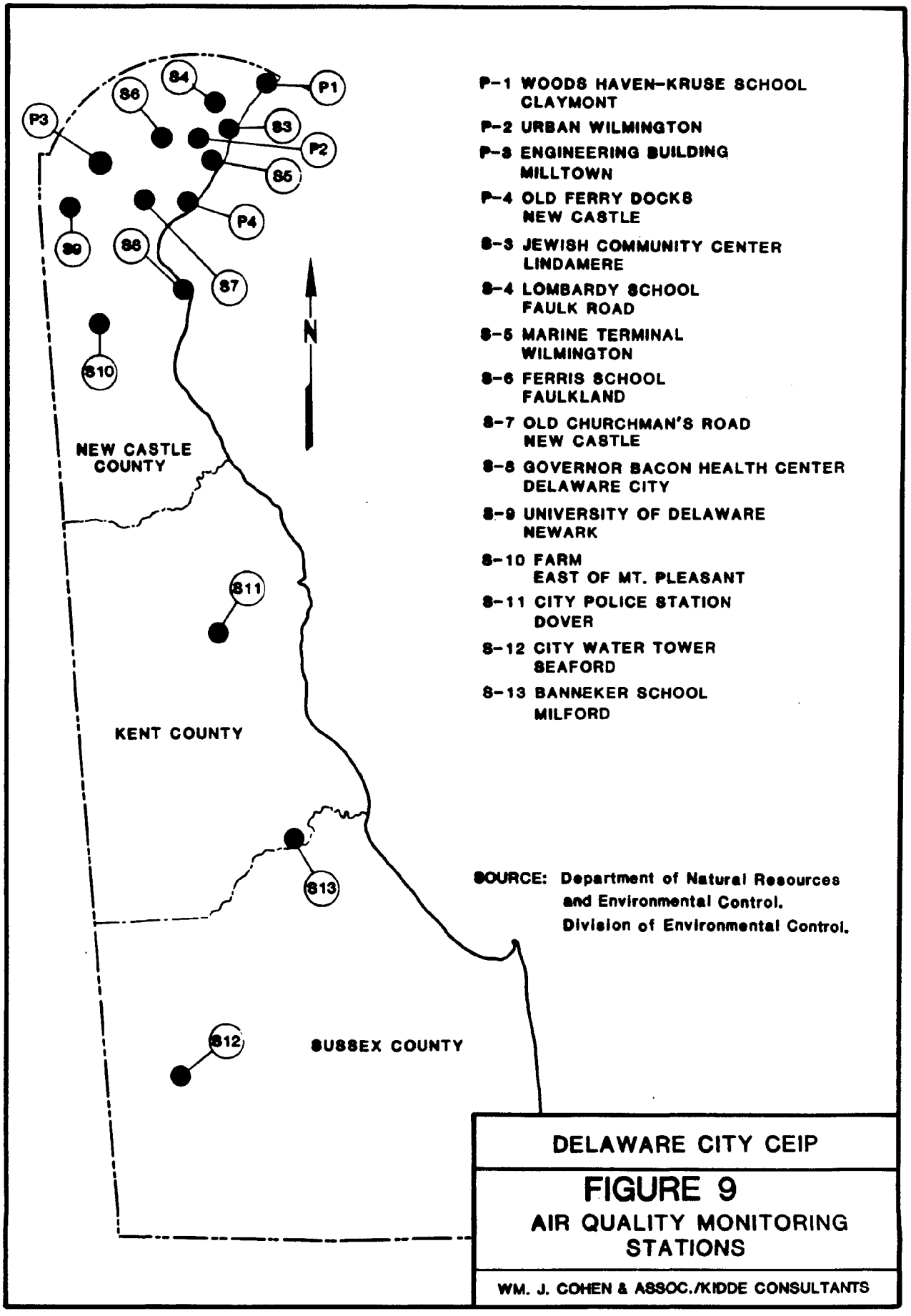
Both Figure 11 and Figure 12 represent a plot of annual average pollution levels calculated each month at the end of a 12-month period. This type of analysis yields a smoother trend line than if each month's average level were plotted.

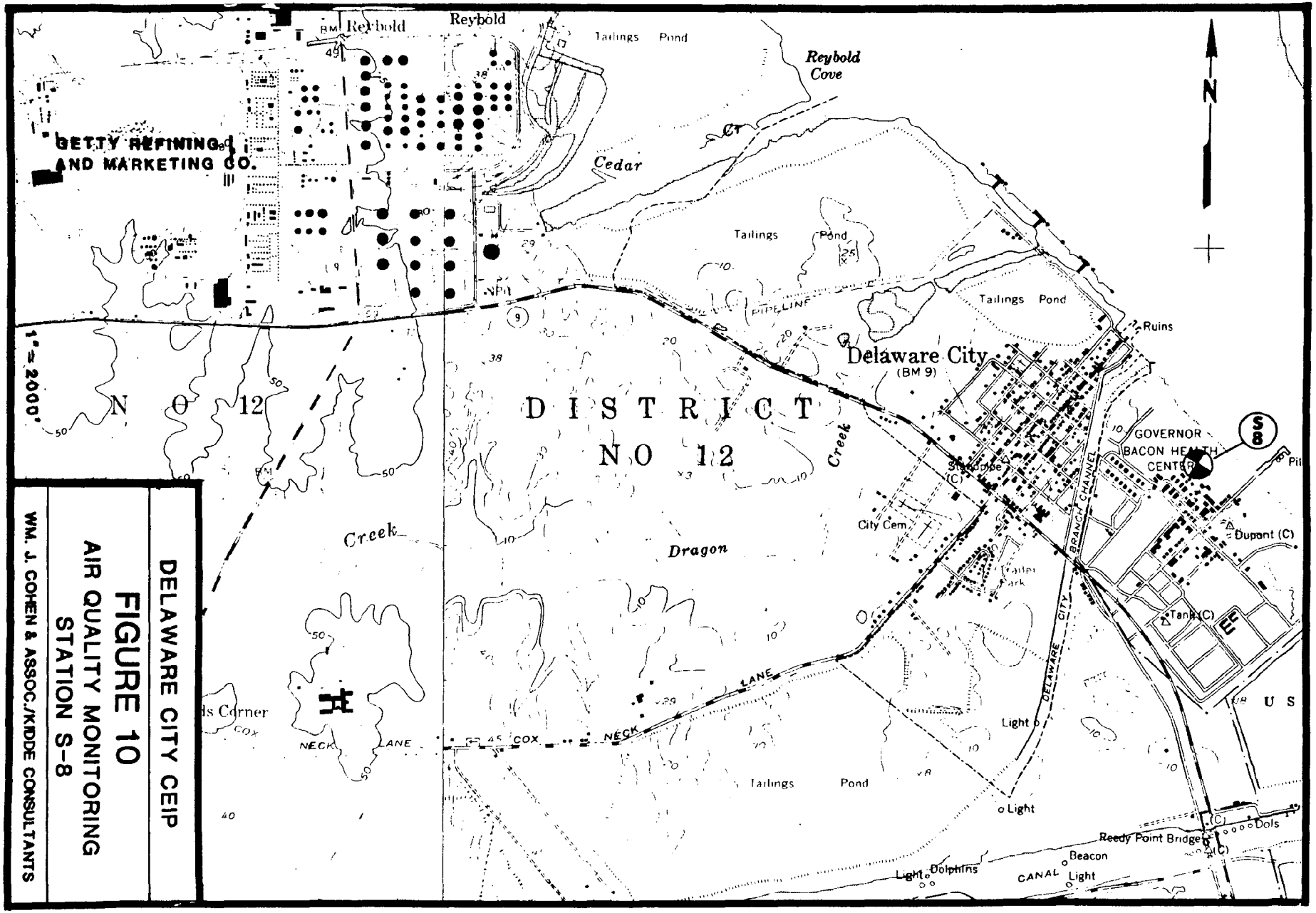
As Figure 11 indicates, the sulfur dioxide trend was fairly constant until the end of 1978 when the values began to fall. This decline continues until a leveling-off period in mid-1980. The annual average has been fairly constant since that time. Figure 11 also indicates that the annual levels have been significantly below the ambient air quality standard for the last two years.

As Figure 12 shows, the annual suspended particulate levels have not changed significantly during the study period. The annual levels have generally remained in the 40 to 50 ug/m^3 range since 1976, although there has been a noticeable decline for the last year and a half. The annual suspended particulate levels have remained below the ambient air quality standard of 60 ug/m^3.

In addition to reporting trends in air pollutants, the DNREC also reports the yearly maximum, second highest, and minimum readings. The readings for sulfur dioxide and suspended particulates are summarized in Table 4 and Table 5. The maximum readings are compared to the air quality standard for maximum 24-hour concentrations. The second highest levels are provided to indicate whether or not the maximum level is an anomaly. The annual means and corresponding primary ambient standards are also presented.

As Table 4 indicates, the maximum 24-hour standard for sulfur dioxide was exceeded in 1977 and approached in 1976 and 1978. Since 1979, however, the maximum


P-1 WOODS HAVEN-KRUSE SCHOOL
CLAYMONT
P-2 URBAN WILMINGTON
P-3 ENGINEERING BUILDING
MILLTOWN
P-4 OLD FERRY DOCKS
NEW CASTLE
S-3 JEWISH COMMUNITY CENTER
LINDAMERE
S-4 LOMBARDY SCHOOL
FAULK ROAD
S-5 MARINE TERMINAL
WILMINGTON
S-6 FERRIS SCHOOL
FAULKLAND
S-7 OLD CHURCHMAN'S ROAD
NEW CASTLE
S-8 GOVERNOR BACON HEALTH CENTER
DELAWARE CITY
S-9 UNIVERSITY OF DELAWARE
NEWARK
S-10 FARM
EAST OF MT. PLEASANT
S-11 CITY POLICE STATION
DOVER
S-12 CITY WATER TOWER
SEAFORD
S-13 BANNEKER SCHOOL
MILFORD
P1
P2
P3
P4
S3
S4
S5
S6
S7
S8
S9
S10
S11
S12
S13
N
NEW CASTLE COUNTY
KENT COUNTY
SUSSEX COUNTY
SOURCE: Department of Natural Resources and Environmental Control. Division of Environmental Control.
DELAWARE CITY CEIP
FIGURE 9
AIR QUALITY MONITORING STATIONS
WM. J. COHEN & ASSOC./KIDDE CONSULTANTS

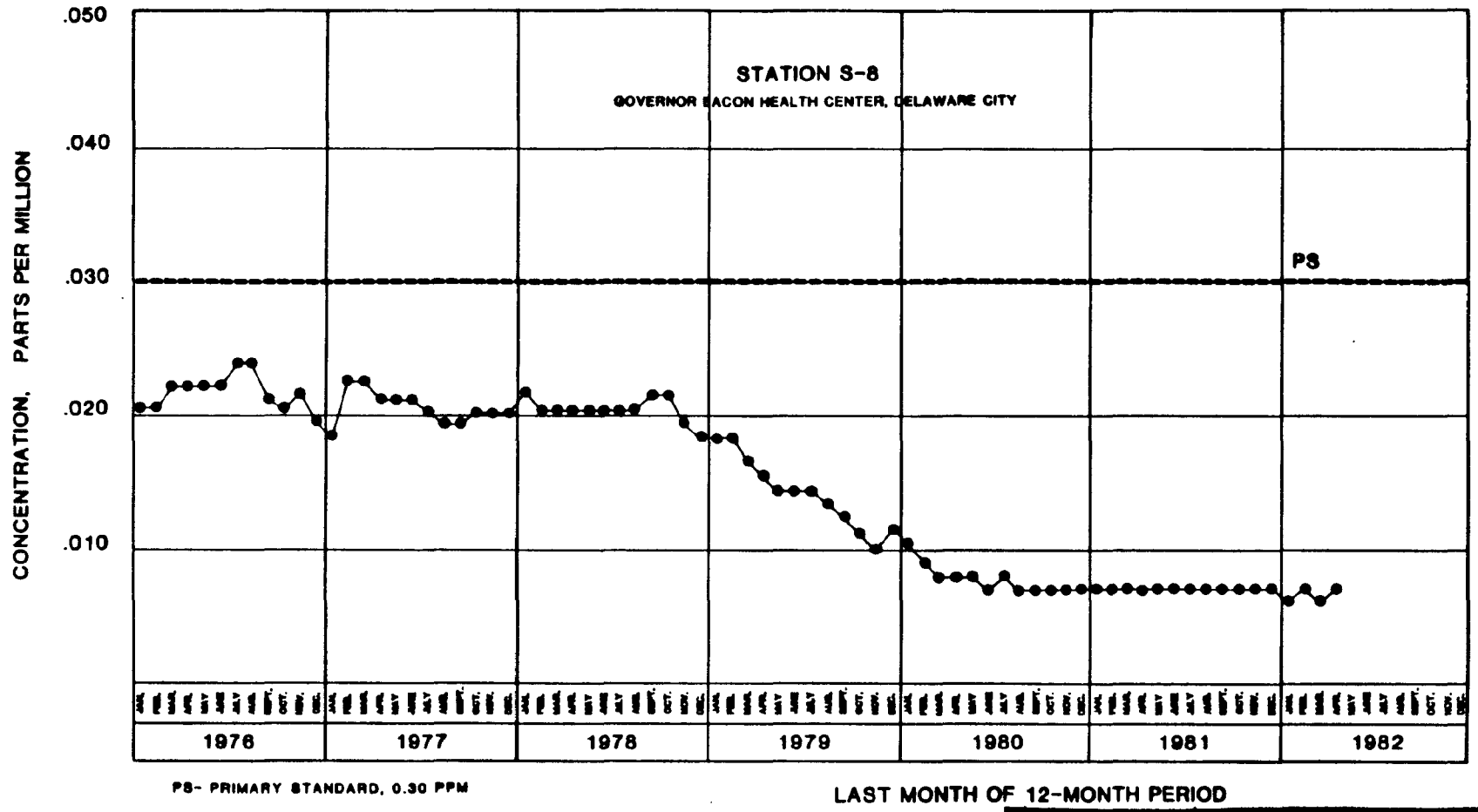


DELAWARE CITY CEIP

FIGURE 10

AIR QUALITY MONITORING STATION S-8

WM. J. COHEN & ASSOC./KIDDE CONSULTANTS



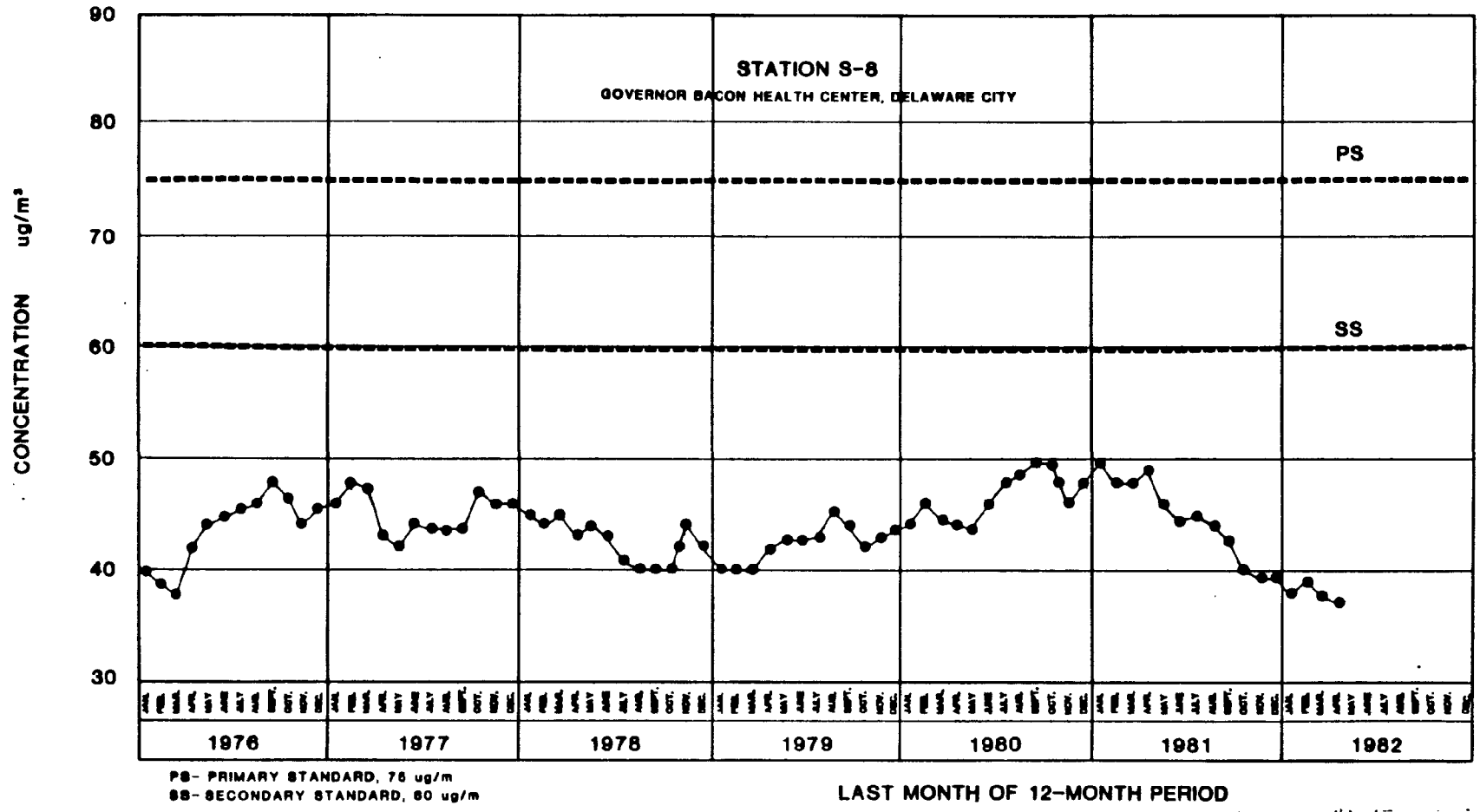
SOURCE: MONTHLY AIR QUALITY DATA SUMMARIES
DEPARTMENT OF NATURAL RESOURCES
AND ENVIRONMENTAL CONTROL DIVISION OF
ENVIRONMENTAL CONTROL

DELAWARE CITY CEIP

FIGURE 11

SULFUR DIOXIDE
1976-1982

WM. J. COHEN & ASSOC./KIDDE CONSULTANTS



SOURCE: MONTHLY AIR QUALITY DATA SUMMARY
DEPARTMENT OF NATURAL RESOURCES
AND ENVIRONMENTAL CONTROL DIVISION
OF ENVIRONMENTAL CONTROL

DELAWARE CITY CEIP

FIGURE 12

SUSPENDED PARTICULATES
1976-1982

WM. J. COHEN & ASSOC./KIDDE CONSULTANTS

values have remained significantly below the ambient standard. The primary ambient standard for annual arithmetic mean was not exceeded during the study period; however, it was approached in 1976, 1977 and 1978. Since 1979, the annual values have remained significantly below the standard.

Table 5 summarizes the suspended particulate levels recorded at Delaware City since 1976. The maximum levels approached the primary ambient standard only in 1976. The trend of the maximum levels is downward except for 1980. The annual geometric mean values have remained in the 40 to 48 ug/m^3 for most of the study period. This compares favorably with the 75 ug/m^3 primary standard. The highest geometric mean during the period occurred in 1980.

Another indication of historical pollution levels are the mass emissions inventories kept by DNREC. Table 6 lists the estimated annual emissions for Getty and Delmarva Power and Light for the years 1976-1981. As this data indicates, there has been little overall change in any of the total annual mass emissions. Currently, these emissions are in compliance with DNREC mass emission standards.

TABLE 4

SUMMARY OF SULFUR DIOXIDE LEVELS RECORDED AT STATION S-8 (ppm)

	24 Hr. 2nd High	24 Hr. Max.	24 Hr. Ambient Standard	24 Hr. Min.	Ann. Arith. Mean	Annual Primary Standard
1976	N.A.	0.10 3/13/76	0.14	0.00	0.019	0.03
1977	0.18 10/15/77	0.22 2/6/77	0.14	0.00	0.02	0.03
1978	N.A.	0.11 3/9/78	0.14	0.00	0.018	0.03
1979	0.055 2/5/79	0.059 1/28/79	0.14	0.00	0.010	0.03
1980	0.040 12/27/80	0.047 9/26/80	0.14	0.00	0.006	0.03
1981	0.035 10/8/81	0.049 1/16/81	0.14	0.00	0.006	0.03
1982 (March)	0.036 1/17/82	0.039 3/22/82	0.14	0.00	N.A.	0.03

N.A. Not Available

TABLE 5

SUMMARY OF SUSPENDED PARTICULATE LEVELS RECORDED AT STATION S-8
(ug/m^3)

	24 Hr. 2nd High	24 Hr. Max.	24 Hr. Primary Standard	24 Hr. Min.	Ann. Geo. Mean	Annual Primary Standard
1976	172 4/12/76	173 8/22/76	260	12	45.3	75
1977	N.A.	101 7/18/77	260	13	46.4	75
1978	N.A.	116 8/24/78	260	18	42.8	75
1979	75 8/19/79 8/31/79	89 10/18/79	260	17	42.8	75
1980	109 1/22/80	171 2/3/80	260	12	48.0	75
1981	93 1/16/81	96 7/3/81	260	19	39.1	75
1982 (March)	84 4/28/81	96 7/3/81	260	19	N.A.	75

N.A. Not Available

TABLE 6

EMISSIONS FOR GETTY OIL AND DP & L DELAWARE CITY PLANT FOR YEARS 1976 - 1980 IN TONS PER YEAR

Getty Oil

	1976	1977	1978	1979	1980
SO_x	25,798	25,798	25,798	25,798	25,798
CO	2,076	2,076	2,076	2,076	2,076
HC	6,812	6,812	6,812	6,817	5,480
NO_x	1,052	1,052	1,052	1,052	1,052
TSP	3,373	3,373	3,373	3,373	3,373

Delmarva Power and Light

SO_x	30,120	31,635	30,051	29,255	29,822
CO	211	198	291	213	203
HC	45	36	53	33	43
NO_x	5,636	4,787	5,715	5,181	5,201
TSP	137	143	205	204	190

Climate and Meteorology

The climate of Delaware City is influenced to a considerable extent by the Delaware River, the Delaware Bay, the Atlantic Ocean and the Chesapeake Bay. The summers are warm and humid, with the average daytime temperatures usually in the eighties. January is usually the coldest month of the year, with an average daily temperature of 32^0 F.

The inflow of southerly winds and the proximity to large water bodies cause the relative humidity to remain high. Most of the precipitation falls in the form of rain, with most of the rainfall coming in the summer months.

In order to accurately determine the most probable wind conditions, the wind distribution records for Greater Wilmington Airport were examined. The relative frequencies for each compass direction are summarized through the use of a wind rose, as presented on Figure 13. As the wind rose indicates, the dominant wind direction is from the northwest. The records also indicate that most of the time, the wind speed is between 4 and 16 knots out of this direction. On the average, the wind blows from the northwest 43 days per year (11.8%).

Other high-frequency wind directions include west-north west (9.6%), west (9.1%) and north-northwest (8.0%).

The meteorological data indicates that the most frequent wind condition brings air currents from the vicinity of the Getty refinery towards Delaware City. This condition obviously exacerbates the air quality problem in Delaware City.

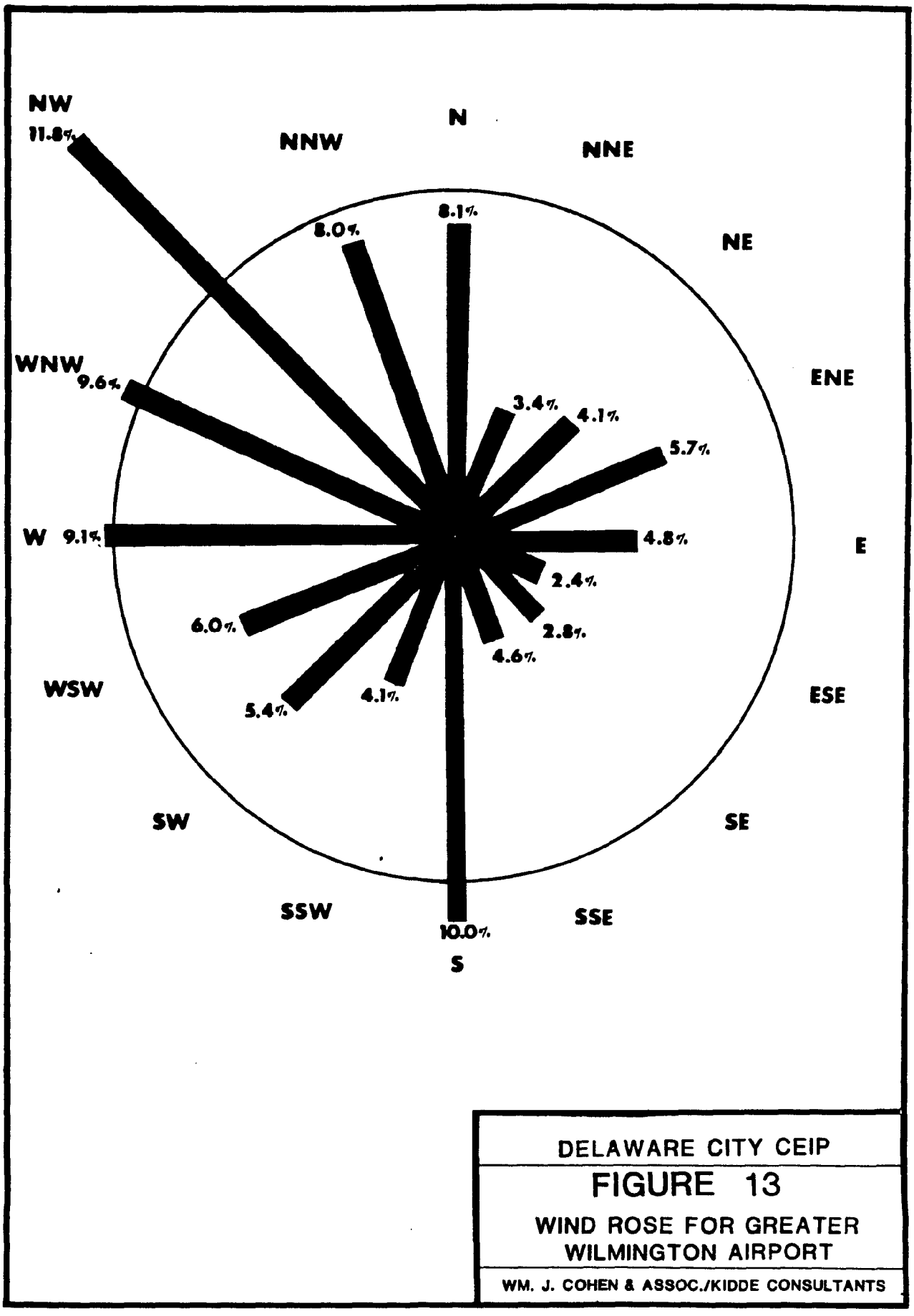
Getty Compliance with the State Air Quality Regulations

The control of emissions at the Getty refinery has been a long uphill battle between the State DNREC and Getty. Often, the battle has taken place at public hearings and in the courts. Citizen groups, such as Delaware Citizens for Clean Air, have also joined in the effort to reduce the impact of the refinery on regional air quality.

Most of the controversy over the last 10 years has centered around the sulfur removal process. Getty has a contract with Delmarva Power and Light to provide fuel for its boilers. For many years, DP and L was burning coke with extremely high sulfur content and as a result, was releasing high concentrations of SO_2 into the atmosphere. In 1975, the U.S. District Court for the District of Delaware ordered Getty and DP and L to install sulfur removal equipment. This equipment was finally installed in 1978 at a cost of some $92 million. Some of this investment is being reclaimed through the sale of the recovered sulfur.

Getty's position throughout this period has been to legally postpone attempts at enforcement until they were either forced to do so, or until it became economically feasible. This kind of attitude, however, is not unusual, especially for corporations with large financial and legal resources. It is DNREC's opinion, however, that once forced to take corrective action, Getty has been both enthusiastic and cooperative in providing the best possible equipment.[1]

Another indication of Getty's attitude towards compliance is their variance record. When industries have to shut down pollution control equipment for repair or maintenance, they must request a temporary variance. During the down period, pollutants are emitted at a significantly higher rate than normal. From September 11, 1974 to July 31, 1981, Getty requested 23 temporary variances (See Table 7). The length



DELAWARE CITY CEIP

FIGURE 13

WIND ROSE FOR GREATER WILMINGTON AIRPORT

WM. J. COHEN & ASSOC./KIDDE CONSULTANTS

TABLE 7

GETTY VARIANCES

Variance No.	Date Requested	Reasons	Granted	Period	Extension
74-A-13	Sept. 11, 1974	Leaking tube on CO Boiler	Sept. 13, 1974	30 days	No
74-A-16	Dec. 6, 1974	Severe corrosion of H_2O cooler	Dec. 16, 1974	15 days	No
75-A-1	March 10, 1975	CO Boiler leaks	March 12, 1975	30 days	No
75-A-2	April 16, 1975	Shutdown for repair & maintenance of the sulfur Recovery Plant	May 9, 1975	21 days	No
75-A-6	Aug. 27, 1975	Failure of circular pump tail gas unit	Sept. 9, 1975	60 days	No
75-A-7	Dec. 1, 5, 8, 1975	Failure of exhaust blower on Sulfur Recovery Plant	Dec. 12, 1975	60 days	No
75-A-8	Feb. 6, 1976	Ext. Mod. to Beavson Stretford Unit	March 17, 1976	60 days	Issued TEV because of hearing-Issued variance July 15, 76-A-5
77-A-1	Jan. 6, 1977	High pressue drop across convertor Sulfur recovery unit	Jan 17, 1977	30 days	No
77-A-60	March 2, 1977	High pressure drop across absorber Tower BSRU	March 3, 1977	19 days	No
78-A-3	Feb. 9, 1978	Blower failure Beavson Stretford Unit	Feb. 17, 1978	60 days	No
78-A-4	April 4, 24, May 9, 1978	High pressure drop absorber tower blower failure	May 17, 1978	60 days	No
78-A-7	Aug. 30, Sept. 18, 1978	Cooling tower problems BSRU	Sept. 26, 1978	60 days	Have Getty Amend 10/3; Max. eff. of Claus Unit.

TABLE 7 Continued

Getty Variances

Variance No.	Date Requested	Reasons	Granted	Period	Extension
78-A-8	Dec. 4, 1978	Shorting of electrostatic precipitator on fluid coker	NOT ISSUED;	RETURNED TO SERVICE	
78-A-3	March 19, 1979	Replacement of catalyst BSRU	March 26, 1979	30 days	No
78-A-6	June 8, July 3, 1979	High pressure drop across Claus convertor; install new mixer in BSRU	July 18, 1979	35 days	No
80-A-3	April 3, 1980	To increase efficiency	April 29, 1980	60 days	No
80-A-4	July 8, 1980	Explosion caused damage to electrostatic precipitor	July 21, 1980	60 days	Ext. 60 days. Allow more time for repairs.
80-A-5	July 28, 1980	High pressure drop BSRU	NOT ISSUED:	RETURNED TO SERVICE	
81-A-1	Dec. 29, 1980	Excessive pressure drop in Claus plant	Jan 8, 1981	30 days	Yes-15 days
81-A-3	Feb. 20, 1981	Claus Sulfur Recovery Unit	Feb. 27, 1981	30 days	No
81-A-4	June 15, 1981	Pressure drop in BSRU	June 29, 1981	10 days	No
81-A-5	July 31, 1981	Sulfur Plant Incin. Stock	Aug. 14, 1981	74 days	No

of the variances ranged from 15 days to 120 days. Most of them, however, were for either 30 or 60 days.

Effects on Delaware City

The direct effects of the Getty pollutant emissions upon the citizens of Delaware City are difficult to quantify. Clearly, the SO_2 and suspended particulates from the refinery operations do frequently reach Delaware City. Often the sulfur odors of the refinery can be noticed throughout the City. On other occasions, visible emissions can be seen from Delaware City.

On an average basis, pollutant levels monitored at Governor Bacon have consistently remained within acceptable limits (i.e. acceptable to EPA and DNREC). The number and frequency of the temporary variances, however, indicates that Delaware City may be experiencing elevated doses of pollutants on a frequent basis.

There has also been some concern expressed over the possibility of harmful fine respirable particles being released at the Getty Plant. These fine particles are often released by aging electrostatic precipitators and are difficult to adequately measure.[2]

The most controversial air quality incident occurred not as a result of refinery process emissions, but rather as a result of materials handling and storage. Periodically, Getty must dredge the shipping channel leading from their tanker piers to the main Delaware River channel. The dredge material is pumped from the dredge to material spoils areas. These spoils areas are diked to contain the slurry-like material until it dewaters and dries. There are two Getty designated spoils areas near Delaware City (See Figure 14). Spoils area number 3 has an area of 222 acres and spoils area number 4 has an area of 32 acres.

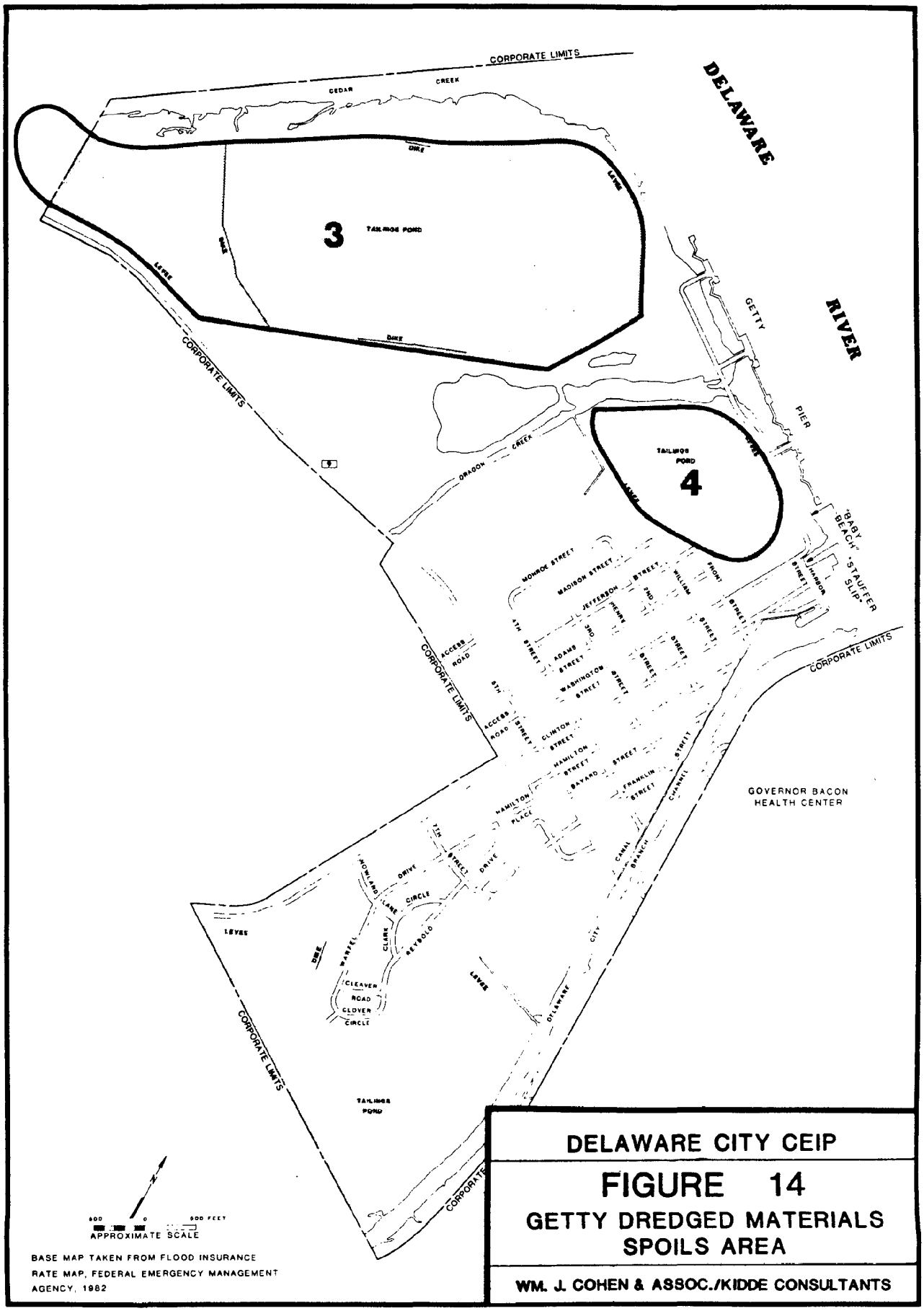
In January of 1980, strong northerly winds blew across these spoils areas and carried quantities of dried powdery silt into the residential section of Delaware City. (This incident is borne out by the maximum and second highest particulate levels shown under 1980 on Table 5). The silt accumulated on homes and automobiles. There were numerous complaints of aggravated upper respiratory problems, particularly among older residents.

The incident was promptly reported to Getty and to the Air Resources Section of DNREC. Getty responded by treating the dredged material storage areas with a water application to reduce the dusting. DNREC sent inspectors to Delaware City to collect samples of the silt.

The results of DNREC's analysis indicated that most of the silt particles were larger than 12.5 microns. (10 microns is usually considered the largest size for inhaled suspended particulates). The analysis also indicated that the silt contained fly ash magnetite, hemotite, quartz and various other minerals.

The City Manager of Delaware City felt it was advisable to make further tests to determine if there were any carcinogenic agents in the silt. He therefore had another analysis performed by an independent laboratory. The laboratory's report is included in Appedix C.

The report was also forwarded to George Fekete of the Environmental Protection Agency. His follow-up assessment is also included in Appendix C. EPA indicates in their assessment that, "the trace metals found in the particulate matter found in the vicinity of the dredge piles are lower or equal to those of normal street dirt".[3]



DELAWARE CITY CEIP

FIGURE 14

GETTY DREDGED MATERIALS SPOILS AREA

WM. J. COHEN & ASSOC./KIDDE CONSULTANTS

The scientific evidence regarding the blowing silt problems indicates that the material carried into the City from the spoils area does not represent a long-term health problem. Clearly, however, the dusting of the entire City by this dredged material is a temporary health and aesthetic problem that can and should be remedied.

ODOR IMPACT ANALYSIS

The previous discussion centered on the issue of air quality as indicated by the measured presence of certain pollutants in the ambient air which are commonly emitted by petroleum refineries. Another important dimension of air quality relates to the presence of unpleasant odors in the ambient air. While it is true that not all air pollutants which may be harmful to life have a distinguishing or noticeable odor, many of them do. Pollutants commonly associated with refining, including sulfur oxides, nitrogen oxides, sulfides, and ammonia, give off tell-tale odors which are generally found to be offensive to nasal sensors.

Odor is largely a subjective phenomenon. That is to say, different people notice odors in different ways and to different degrees. To a certain extent, what may be a fragrant essence to one person may be an objectionable odor to another person. There have been efforts to make odor research more quantifiable, however, such methods are unproven and therefore provide potentially unreliable results.

At the same time, odors can be a real source of annoyance, and it has been found that, by and large, people exposed to the same odor will generally respond in similar ways.

The presence of unpleasant odors has been a consistent complaint of Delaware City residents against the Getty refinery. In fact, complaints have been lodged against the refinery even when the source of odors cannot be definitely traced to the refinery, which could be construed as a prejudicial response. In order to substantiate the existence and extent of odor problems in Delaware City, a survey was undertaken by the Consultant to clarify the perceptions of town residents relative to the odor issue. The results of this survey are presented below.

Resident Odor Survey

In April, 1982, a written survey questionnaire was distributed to each household in Delaware City (A copy of the questionnaire can be found in Appendix D). The survey was brief and direct, attempting to ascertain whether the citizens of Delaware City experienced any odors (pleasant or unpleasant), how severe any problem was, and how often it occurred. The town was divided into three geographical sections (see Figure 15), under the hypothesis that location within the town might account for differences in odor perception. Throughout the questionnaire, no reference was made to the Getty refinery, in order to minimize prejudicial responses. However, this also means that conclusions drawn from the results of the survey cannot be applied exclusively to Getty, since there are other industrial facilities in the area which may contribute to odor problems. At the same time, based on the relative scale of Getty's operations, and also based on the knowledge that the refinery does produce odor-causing emissions, strong inferences can be made to the refinery as a major source of any unpleasant odors in the area.

Based on the initial analysis of the survey results, it was determined that the variety of responses did not appreciably differ among the three geographical sections. Accordingly, all findings presented in the following pages have been combined for the town as a whole.

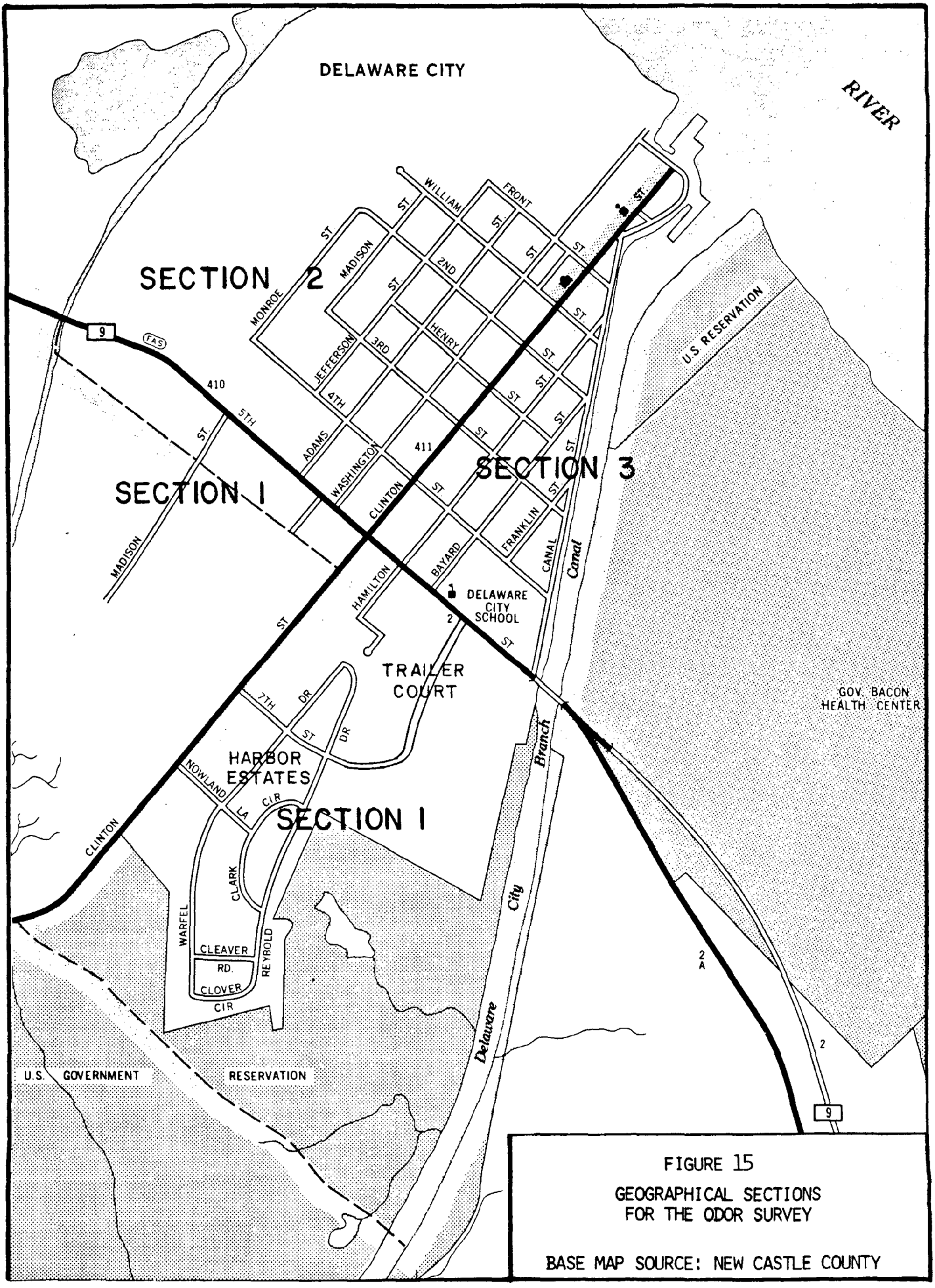


FIGURE 15

GEOGRAPHICAL SECTIONS FOR THE ODOR SURVEY

BASE MAP SOURCE: NEW CASTLE COUNTY

These findings, while not statistically sophisticated, provide some significant and revealing information. For instance, the existence of unpleasant odors was reported by 97 percent of the respondents (58 out of 60). The next question asked each respondent to describe the quality of odors, as usually noticed in the vicinity of the respondent's home. The distribution of responses is shown in Table 8 below.

Table 8

DESCRIPTION OF ODORS USUALLY EXPERIENCED

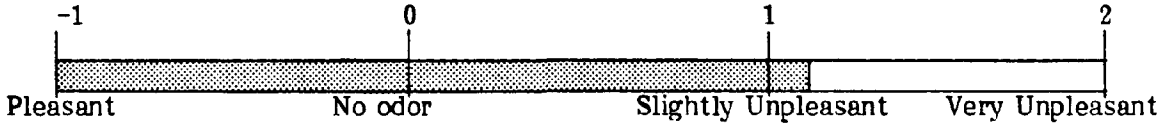
Description	Responses	Percent
Usually pleasant	4	6.7
Usually no odor	12	20.0
Usually slightly unpleasant	17	28.3
Usually very unpleasant	27	45.0
Total	60	100.0

Source: William J. Cohen and Associates, Inc.

As part of the analysis of the responses to this question, each of the descriptions was assigned a numerical point value, accomplished in the following manner:

"Usually pleasant"	=	(-1) point
"Usually no odor"	=	0 points
"Usually slightly unpleasant"	=	1 point
"Usually very unpleasant"	=	2 points

For each person's response, the appropriate point value was recorded. Then, the points for all respondents were summed (negative points reduced the sum), and the sum was divided by the number of respondents, thereby providing an average score. On the scale of (-1) to 2, the total group of respondents reported an average score of 1.12, depicted in the continuum below.

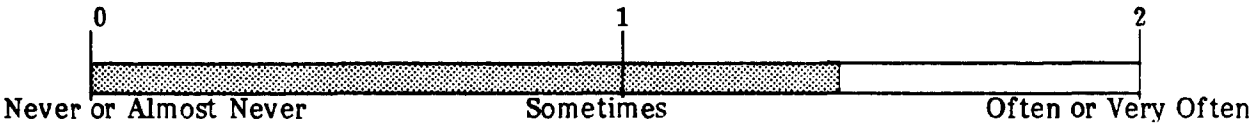


The next question asked the respondent to describe the frequency at which an unpleasant odor was noticed. This question drew responses nearly evenly divided between "often or very often" (27 out of 59, or 47 percent) and "sometimes" (29 out of 59, or 48 percent). Only three respondents (5 percent) reported "never or almost never" noticing unpleasant odors.

These responses were also assigned numerical point values in the following manner:

"Never or almost never"	=	0 points
"Sometimes"	=	1 point
"Often or very often"	=	2 points

As was done with the previous question, individual responses were appropriately scored and an average score for the entire group was calculated. On the scale of 0 to 2, the whole group reported an average score of 1.42, depicted in the continuum below.



To better understand the correlation between the unpleasantness of odors noticed by respondents and the frequency with which they were noticed, a cross-tabulation of individual respondents' answers was performed and is shown in Table 9 below.

Table 9

FREQUENCY AND SEVERITY OF ODOR PROBLEMS

Response	Number	Percent	Cumulative Percent
Usually very unpleasant, often	19	31	31
Usually very unpleasant, sometimes	7	12	43
Usually slightly unpleasant, often	7	12	55
Usually slightly unpleasant, sometimes	11	18	73
Other responses	16	27	100
Total	60	100	100

Source: William J. Cohen and Associates, Inc.

It can be seen from Table 9 above that unpleasant odors are perceived to be at least an occasional problem by a substantial proportion of Delaware City residents who responded to the questionnaire, representing 73 percent of all respondents.

Although the questionnaire did not specifically request it, several of the respondents offered additional comments about the odor problems which provide additional insight. Two respondents reported that odor problems had been occurring more frequently of late. One reported that odor problems occurred two or three times per year in the early 1970's, but that they were recently noticed two or three times a month. Another survey respondent commented that odor problems are most severe when the weather is rainy or foggy. One person claims to have become ill from the odors on two occasions. Other respondents described "cat urine" and "burned onion" odors. Another person contended that one of these odors has been noticed almost continually since the waste water treatment plant was installed.

Conclusions

While the results of the odor survey have several noteworthy implications toward a more thorough understanding of odor problems experienced by residents of the town, several cautionary points should be considered. They are as follows:

1. Because of the fact that the experiencing of unpleasant odors is a relatively subjective matter, it is probable that the results of this survey are skewed to a certain extent. To avoid additional problems of reliability, the questions were deliberately posed so as to not request a level of response that might have been too specific for respondents to accurately indicate. As a result, however, the response categories can be construed as somewhat vague. At the same time, notions of what is "very often" are, in reality, just as subjective as notions of what is "very unpleasant". Therefore, the survey results should be interpreted as a simple portrayal of the respondents' perceptions, however subjective they may be.

2. It should be pointed out that only 60 respondents completed the questionnaire and returned it, representing only ten percent of all households in the town. While this level of response is common for the type of survey which was conducted, it still means that 90 percent of the households did not report their perceptions. It cannot be known whether or not the responding sample provides an accurate picture of the experiences of the entire communty. It could be just as false to assume that nonrespondents agree with the respondents, as it would be to assume that nonrespondents have no complaints about odors. Therefore, caution must be exercised in applying the results of the survey as a basis for conclusive statements about the odor issue.

3. Since Getty was not singled out as a potential source of unpleasant odors (to minimize prejudicial responses), conclusions from the survey cannot fairly be directed exclusively to the refinery. However, as was pointed out earlier, the refinery is by far the largest industrial facility in the area, and therefore, would tend to be a major source of odors, especially since it is known to emit odor-producing compounds into the air.

Having expressed these cautions, it is still reasonable to conclude that, for at least a majority of those who responded to the survey, odor problems are significant. These findings are consistent with other research into odor problems, and suggest that any remedies which Getty can implement either voluntarily or by State requirement would be very helpful in improving the quality of life for the people of Delaware City.

The unpleasant odors from the Getty refinery affect an area far beyond Delaware City. According to officials of the Delaware Division of Environmental Control, when odor problems are most severe, the majority of complaints do not come from Delaware City, but from residential areas to the north and west of the refinery. Since the prevailing wind pattern in the Delaware City area is alternately from the northwest and from the south, the brunt of Getty's air emissions is not always carried over Delaware City. Winds which would carry emissions (and odors) over the town occur approximately 30 percent of the time (refer to Figure 13, earlier in this chapter). At other times, these emissions and odors are carried northward, eastward, and to a much smaller degree, in other directions. In fact, odors from the Getty refinery have, from time to time, been noticed as far away as downtown Wilmington and across the river in New Jersey.

Even when odors have been definitely attributable to the refinery operations, the exact source of the odor is not always identifiable. The State of Delaware has been actively monitoring the problem and enforcing regulations for almost 20 years. Although Getty has usually responded to complaints and taken a number of actions to reduce odor problems, State officials contend that only recently has Getty become truly concerned and committed to a detailed program to reduce or eliminate the odor problem.

Three specific areas of the refinery have been singled out as major sources of odors. As a result of a period of especially acute odor problems in May 1982 (the State received 130 complaints in one week), Getty has agreed to implement odor control techniques at these three areas. First, the wastewater treatment plant appears to be the most serious source of odors. Odors have been traced to the sour water tankage, water from the flare and flare seal drum, and from process drains. A second major source of odors is the landfill, at which activated sludge from the wastewater treatment plant is disposed. The third source of odors is direct release from process areas. In each of these cases, new emission control techniques are being implemented and inspections are being upgraded to help alleviate the problem. Sulfides and ammonia—major odor producers—are being more effectively managed. Other odor reduction procedures are also being implemented, in accordance with a comprehensive program to more effectively control air emissions in general.

It has been pointed out by enforcement officials with the State Division of Environmental Control that a recently-adopted strategy to accomplish these objectives cooperatively with Getty officials, appears to be yielding more positive results than previous strategies which placed more emphasis on confrontational and punitive techniques. However, State officials have not permanently discarded the confrontational and punitive approaches, and they maintain that they are monitoring the effectiveness of the current cooperative strategy. Should it fail to continue providing positive results, it is further maintained that punitive measures will be reactivated. A recently-settled enforcement suit brought against Getty, stemming from an odor incident during December 1980, resulted in the levy of a $4,000 penalty assessment on the company. This punitive mechanism, which was initiated prior to the implementation of the new cooperative strategy, is not considered to be very meaningful from a financial standpoint, but does carry some weight from an image standpoint, and will be used again in the future if necessary.

One potential regulatory remedy which is in the hands of Delaware City itself is Section 10-30 of the Delaware City Health and Sanitation Code. This code established a Board of Health for Delaware City which is empowered to investigate health problems, develop health regulations, and enforce the code. Section 10-30 states the following:

> "No person shall maintain any rendering or reduction plant or any plant engaged in the manufacture of materials or any condition which creates obnoxious or offensive odors, fumes, gases or smoke, except in accordance with the rules and regulations of the Board of Health."

Since the sources of Getty's odor problems do not lie within Delaware City's boundaries, a jurisdictional question would need to be resolved to determine if the City is empowered to regulate odors reaching the City as a result of the refinery operations.

RECOMMENDATIONS - EMISSIONS

The recommendations with respect to the impact of Getty air emissions are separated into two categories: refinery process emissions and blowing silt.

Although the Getty Plant was visited during the course of this project, it is well beyond the scope of this study to assess either the efficiency or the propriety of Getty's anti-pollution equipment. It must be assumed that this equipment conforms to all State and Federal regulations. It is also inappropriate for this study to assess the effectiveness of the DNREC Air Resources Section. This study is intended to discuss the impact of coastal energy facilities on Delaware City as defined by regulatory authorities.

The recommendations to Delaware City concerning process emissions are not,

therefore, physical in nature. Instead, they center on developing an awareness by the City of how to participate in the regulation of air quality in their community.

Many of the air quality variances sought by Getty are subject to the holding of public hearings. At each request for a variance, DNREC notifies interested parties of Getty's application. It is recommended that Delaware City get involved in the variance process. A representative of the City should contact:

Mr. Robert French
State of Delaware
Department of Natural Resources &
Environmental Control
Division of Environmental Control
Air Resources Section
Edward Tatnall Building
P.O. Box 1401
Dover, Delaware 19901
Telephone: (302) 736-4791

The City may also want to obtain technical assistance before testifying at public hearings. This assistance can be obtained from DNREC. If the City feels that a more aggressive approach to dealing with Getty is necessary, they can contact:

Delaware Citizens for Clean Air
c/o Mr. Jacob Kreshtool
1102 West Street
Wilmington, Delaware 19801
Telephone: (302) 656-9850

In order to take some action with respect to the fine particulates issue, it is recommended that Delaware City insist on strict enforcement of DNREC's opacity standard. These standards deal with visible emissions from the refinery's stacks. Unusually heavy or dense emissions should be reported promptly to the Air Resources Section in Dover.

The problem with the blowing silt can be managed through the enforcement of existing regulations and through working with DNREC to possibly avoid the problem in the future. New Castle County has promulgated a Specifications Guide for Sediment and Erosion Control (New Castle County, Delaware, June, 1977). The Standard and Specification Guide for Dust Control, beginning on page 3.61 of the standards, lists temporary and permanent methods for controlling blowing dust (See Appendix B).

DNREC's Regulations Governing the Control of Air Pollution (February, 1981) may also be applied to the dredge spoils areas. Regulation No. VI, Particulate Emissions from Construction and Materials Handling (Section 6.1), states that "No person shall cause or allow stockpiling or other storage of material or transport to or from a storage facility in such a manner as may cause a condition of air pollution." (See Appendix B).

In the event of another blowing silt incident, clearly the first actions taken by Delaware City should be to contact both DNREC and New Castle County to report the dust problem. These agencies should be able to persuade Getty into taking immediate temporary action to control the dusting.

The long-range solution to this problem, however, may lie in laying some groundwork for the future use of the spoils disposal areas by Getty. In order to perform

the maintenance dredging of their channel, Getty must obtain permits from the Army Corps of Engineers and from DNREC. Getty is currently performing maintenance dredging under existing permits granted by DNREC and COE. To continue their dredging projects, Getty must obtain future permits. Delaware City should contact DNREC and the Corps of Engineers and insist on specific language in all future permits to control blowing silt from the dredge spoil disposal areas. The City should also request that public hearings be held to discuss this problem prior to the granting of permits by either DNREC or the Corps of Engineers.

The City should also consider adopting silt handling and storage permit regulations of their own, since the source of the silt problem is within Delaware City corporate limits. These regulations could be patterned after the New Castle County standards. They should be modified, however, to deal directly with the dredge spoil disposal process.

RECOMMENDATIONS - ODOR QUALITY

In the interests of ensuring that the residents of Delaware City have adequate access to regulatory and administrative remedies relative to the occurrence of objectionable odors emanating from the refinery and other nearby industrial facilities, it is recommended that the Mayor and Council pursue the following actions:

1. Invite the State Environmental Protection Officer assigned to the area to meet with town residents at a public meeting. The purpose of this meeting would be to acquaint residents with the current status of regulatory and enforcement efforts relative to odor problems and other matters. In addition, the opportunity can be used to inform residents of the most effective means to report and register complaints about air quality problems, including odors. The Environmental Protection Officer, Jack Egolf, can be reached through the Dover office at 736-4580.

2. Request the City Solicitor to develop a legal opinion, based on Delaware City's granted police powers and any appropriate legal precedents, relative to the City Board of Health's power to regulate obnoxious or offensive odors emanating from the refinery.

CHAPTER NOTES

1 Interview with DNREC officials on April 22, 1982.

2 Interview with Delaware Citizens for Clean Air on August 11, 1982.

3 Letter from George Fekete of EPA to Richard Gilbert, City Manager, dated June 4, 1980.

CHAPTER 6

WATER RESOURCES IMPACT ANALYSIS

INTRODUCTION

The purpose of this section is to assess the impacts of operations at the Getty refinery upon water resources in Delaware City. These impacts have been identified and are described in terms of the extent to which they affect the ability of people in the town to enjoy the benefits of the water resources within, and adjacent to, the incorporated area of the city.

First, these water resources will be described in terms of their interest to Delaware City. They have been classified into two groups: groundwater resources and surface water resources. Next, six specific refinery-based activities or functions which have a current or potential impact upon one or both types of water resources, are described relative to their effects on these resources.

DESCRIPTION OF DELAWARE CITY'S WATER RESOURCES

Groundwater Resources and Their Importance to the Community

The area of which Delaware City is a part sits on several major geologic formations of the Atlantic Coastal Plain which have significant groundwater-bearing capabilities. The most shallow (closest to the surface) layer is called the Columbia formation. The Columbia sediments are approximately 50-60 feet thick at Delaware City. This formation has been identified by hydrologists as having a water table aquifer with significant water-bearing capabilities where the saturated thickness of these sediments is greater than ten feet, as in Delaware City. The aquifer has also been determined to be " . . .important in maintaining the base flow of streams, in furnishing plant life moisture, in maintaining a reservoir of recharge water to the artesian aquifers, and in maintaining the hydraulic gradient that halts the ingress of salt water along the Delaware Estuary and Bay."[1]

The groundwater of the Columbia formation has not been used as a source of municipal water supply in Delaware City for at least four decades. The Tidewater Oil Company (Getty) encountered salt water problems after six years of pumping from a well located in the Columbia aquifer. The company immediately halted withdrawal from this well.[2] As mentioned above, this aquifer performs the important function of halting the ingress of salt water from the Estuary, as long as the water level in the aquifer is maintained at an adequate height. The fact that pumpage from this aquifer in the Delaware City area no longer occurs, probably enables the aquifer to continue performing this vital function. Moreover, it probably continues to perform two other important functions in the Delaware City area: maintaining the base flow of streams, including Red Lion Creek and Dragon Run Creek; and furnishing plant life moisture. The ability of the aquifer to serve as a source of recharge to aquifers underlying it, which are part of the Potomac formation, is probably quite limited around Delaware City. This is due to the existence of a layer of clay deposits which lie underneath the Columbia sediments, and provide a relatively impermeable seal between the aquifers of the Columbia and Potomac formations. Nevertheless, this seal is not perfect, therefore providing the possibility of small amounts of recharge from the Columbia aquifer to the Potomac aquifers over long periods of time.[3] This principle is known as vertical leakage.

The geoligcal formation in the Delaware City area which has the most significant groundwater resources is the Potomac formation. The Potomac sediments underlie the Columbia sediments, and have been determined to be approximately 200-300 feet below the ground surface, and approximately 625 feet thick, at Delaware City.[4] Based on analysis of the structure of this formation, it has been described as having three distinct

layers of groundwater reservoirs—the upper, middle, and lower hydrologic zones.[5] These zones are relatively isolated from each other by layers of clay zones, which act as barriers. However, these barriers have been determined to be somewhat leaky, i.e., there is a small amount of vertical leakage between the three waterbearing zones.

The aquifers of the Potomac formation have been the sole source of Delaware City's water supply since 1941. During the twenty-year period from 1941 to 1961, the community received its water from a well in the upper hydrologic zone. In 1961, when the Delaware City Water Company was purchased by the city from a private owner, pumpage was switched to a new well, located in the lower hydrologic zone. Since that time, all water for the community has come from the lower zone of the Potomac formation, utilizing, at different times, one of three wells which have been drilled in that zone over the years.[6] Table 10 summarizes information about Delaware City's water supplies.

TABLE 10

CITY OF DELAWARE CITY
GROUNDWATER RESOURCES OF THE MUNICIPAL WATER SYSTEM

Well #	Date Drilled	Depth (feet)	Aquifer	Status
1	—	25	Columbia	shut down
2	1941	240	Upper Potomac	stand-by
3	1961	701	Lower Potomac	shut down
4	1976	722	Lower Potomac	in use
5	1977	737	Lower Potomac	stand-by

Source: Water Supply Branch, Department of Natural Resources and Environmental Control.

Due to the city's total reliance on the groundwater resources of the Potomac formation as a source of domestic water supply, the quality of these resources is a crucial matter. Any significant contamination of the Potomac aquifers in the Delaware City area would create potential health hazards relative to the domestic consumption of water by people being served by the municipal water system. This concern applies to people in other parts of New Castle County as well, who also receive water pumped from the Potomac aquifers. In 1974, approximately 15.2 million gallons of groundwater per day were withdrawn for domestic water supplies in New Castle County. Most of this water was pumped from the Potomac aquifers.[7]

Concerns over the potential contamination of the groundwater resources of the Potomac aquifers have become more pronounced over the past decade, as a result of the discovery of several sources of potentially serious contamination. In particular, two "sanitary" landfills, both located in the coastal area south of New Castle and north of Delaware City, have been identified as major sources of contamination. In the case of the Llangollen landfill, localized contamination of wells located in the upper Potomac zone was found to be substantial. The landfill, located adjacent to Route 13 where it converges with Route 40 (see Figure 16), has only contaminated the upper Potomac aquifer which lies in the immediate vicinity of the site. Wells belonging to the Artesian Water Company, the Amoco Chemical Corporation, and a number of private households which are located within several thousand feet of the landfill, are the only ones identified as having been contaminated. Corrective actions taken by New Castle County and the State Department of Natural Resources and Environmental Control (DNREC)

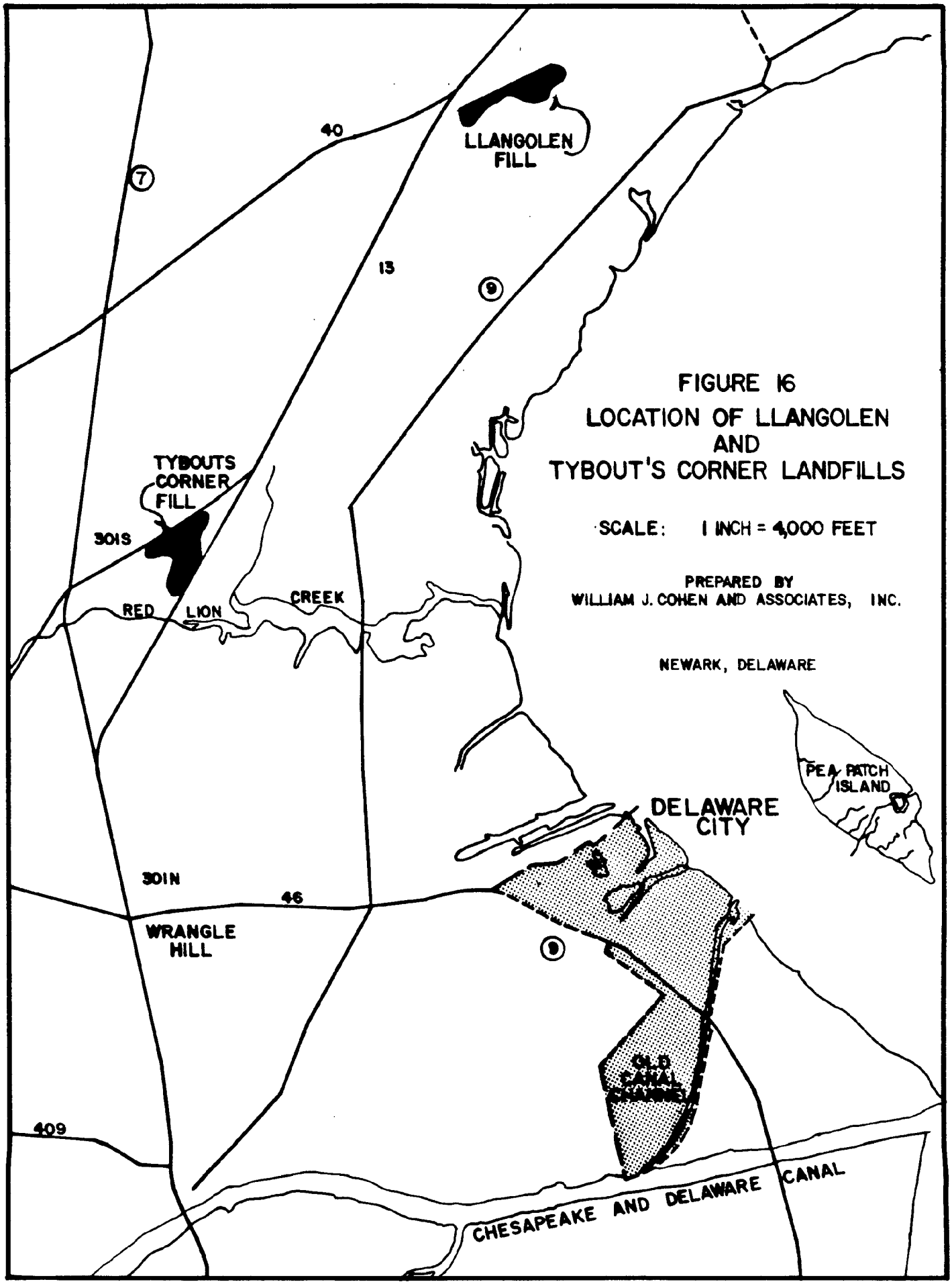


FIGURE 16
LOCATION OF LLANGOLEN AND TYBOUT'S CORNER LANDFILLS

SCALE: 1 INCH = 4,000 FEET

PREPARED BY
WILLIAM J. COHEN AND ASSOCIATES, INC.

NEWARK, DELAWARE

starting in 1973, have had the effect of containing, or even reducing, the migration of contaminants.[8] State and County water resource experts have indicated no concern over the possibility of the contamination from Llangollen spreading toward Delaware City's water supply.[9]

The other landfill about which there has been recent concern is the Tybout's Corner landfill, located in the triangle bounded by Routes 13, 301, and 7 (see Figure 16). This site is adjacent to Pigeon Run, a small tributary which flows into Red Lion Creek, which itself is less than one-quarter mile away from the landfill. During the late 1960's and early 1970's, this landfill was used for the disposal of municipal wastes, and industrial wastes from the Stauffer Chemical Company. Tests of wells within the immediate area of the landifill, conducted since the early 1970's, have revealed contamination in one private well drilled into the upper Potomac zone, located 300 feet east of the landfill. Another well, operated by Getty approximately 200 feet southeast of the landfill, but drilled into the lower Potomac zone, had not revealed any contamination as of the time of the most recent test data available.

The Tybout's Corner landfill, which sits within four miles of Delaware City, was designated by the Environmental Protection Agency in October, 1981 as a priority site under the agency's Superfund program. This designation has led to the appropriation of $400,000 to institute cleanup measures, and to conduct further tests for ground water contamination. Negotiation between the landfill's owners, the County, the State, and the Federal government are currently still underway, toward determining what action needs to be taken.[10]

Based upon discussions with State and other water resource experts, the consultants have been informed that there is no current cause for concern over the effect of this contamination on water supplies in Delaware City.

Surface Water Resources and Their Importance to the Community

There are three significant bodies of surface water in the Delaware City area: Dragon Run Creek, the Delaware River, and the Delaware City Branch Channel of the Chesapeake and Delaware Canal (discussed here as the Old Canal). The primary significance to the town of these surface water bodies relates to their recreational and visual values.

Recreational activities directly associated with surface bodies of water include swimming, fishing, and boating. All three of these activities occur at Delaware City, mainly in the Delaware River and the Old Canal. However, swimming in the Delaware River has been officially discouraged for many years, primarily because of the extensive levels of pollutants which represent a significant health hazard. The major sources of this pollution are many miles upstream, prinicipally coming from the cities of Camden and Philadelphia. Despite the cleanup and regulatory efforts of the Delaware River Basin Commission and the former Interstate Commission on the Delaware River Basin, which have been on-going for more than 35 years, the section of river which passes Delaware City has yet to meet minimum quality standards for "swimmability."[11]

Nonetheless, the surface waters at Delaware City have a significant recreational value, especially for boating and a small amount of sport fishing (commercial fishing, once a vital part of the town's economy, has not existed for 40 years or more). In addition, the 2.1-acre Battery Park, adjacent to the Delaware River and the Old Canal, offers passive recreational opportunities with a waterfront setting. These and other recreation-related issues are discussed in detail in a subsequent chapter of this report.

From a visual standpoint, the bodies of surface water at Delaware City are of great value in enhancing the quality of the visual experience that is obtained in the presence of these waters. The positive psychological effects of surface water environments (unless they are severely degraded), are well-documented. The roles of the Delaware River and the Old Canal, relative to the visual quality of Delaware City, are discussed more fully in Chapter 7.

THE IMPACT OF REFINERY-BASED ACTIVITIES ON DELAWARE CITY'S WATER RESOURCES

Ground Water Usage at the Refinery

During the years between 1954 and 1956, after the Tidewater Oil Company (Getty) had conducted initial groundwater tests and had made the decision to build a refinery at Delaware City, the company began to develop its well field for the extraction of groundwater. A supply of fresh, relatively clean water is essential to a number of refining processes. By 1956, prior to the actual commencement of refinery operations, the company was already pumping an average of 2.25 million gallons per day (MGD) from a field of wells located in the Columbia formation and the upper, middle, and lower zones of the Potomac formation (see Table 11). When the refinery opened in 1957 and for the ensuing several years, pumpage increased to well over four million gallons per day, most of which came from wells in the lower Potomac zone. During the 1960's, Getty's pumpage varied considerably, ranging from a low of 2.1 MGD (1967) to a high of 3.78 MGD (1960), and averaging just under 2.8 MGD for the decade. In more recent years, the company has more consistently pumped from its nine currently-active wells an average of 3.75 MGD. For the past twenty years, all but a small portion of Getty's groundwater supply has come from the lower Potomac aquifers, from which Delaware City has also drawn its water since 1961. Figure 17 shows the locations of wells currently used by Getty and Delaware City.

Getty is the second largest user of groundwater in New Castle County, exceeded only by the Artesian Water Company, which supplies most of the county's domestic water needs.[12] Moreover, the refinery accounts for roughly 40 percent of all industrial self-supplied groundwater usage in the county.[13] By comparison, Delaware City's water usage is miniscule, averaging about 219,000 gallons per day in recent years, or approximately 6 percent of Getty's usage.[14] The withdrawal of groundwater by both Getty and Delaware City is regulated and permitted by the State Department of Natural Resources and Environmental Control (DNREC), Water Supply Branch.

The impact of Getty's groundwater usage on the availability of groundwater in nearby wells has been extensively studied since the refinery began operating. The results of these ongoing analyses have been compiled in two studies prepared by R. W. Sundstrom and T. E. Pickett for the University of Delaware's Water Resources Center. The more recent of the two, The Availability of Groundwater in New Castle County, Delaware (1971), reiterates many of the findings of the first study. It indicates that groundwater pumpage at Getty has had an appreciable effect on water levels throughout the system of Potomac aquifers in the area.[15] Tests conducted at an observation well, drilled in the lower Potomac and located near the center of Getty's well field (well #P-3, as shown on Figure 17), revealed that between 1954 (prior to the operation of the refinery) and 1966, the static water level had declined by 83 feet. In other words, Getty pumpage from the lower Potomac aquifer had reduced water levels in this aquifer by 83 feet, as measured from the center of the company's well field.[16] Getty's pumpage has also been found to have affected water levels in the upper Potomac aquifer, as measured at well #R-4, even though pumpage was primarily from the lower zone. The effect on the upper zone in the

TABLE 11

AVERAGE DAILY PUMPAGE OF GROUNDWATER AT GETTY OIL COMPANY, 1956-70 AND 1979-81

(GALLONS PER DAY)

Year	Aquifer			Totals
	Columbia	Upper Potomac[1]	Lower Potomac	
	(gpd)	(gpd)	(gpd)	(gpd)
1956	496,000	555,000	1,206,000	2,257,000
1957	1,297,000	718,600	2,579,200	4,594,800
1958	1,148,000	718,600	2,864,100	4,731,500
1959	499,500	646,600	3,039,700	4,185,800
1960	399,500	806,800	2,636,700	3,783,000
1961	359,700	574,000	2,843,600	3,777,300
1962		663,800	2,651,500	3,315,300
1963		714,200	2,103,800	2,818,000
1964		688,700	1,786,800	2,475,600
1965		776,960	1,410,300	2,187,260
1966		775,100	1,726,300	2,510,400
1967		556,000	1,564,000	2,130,000
1968		622,000	1,677,000	2,299,000
1969		589,000	1,964,000	2,553,000
1970		636,000	2,285,000	2,921,000
1979		713,151	3,095,068	3,808,219
1980		723,836	2,923,836	2,647,672
1981		795,616	3,013,151	3,808,767

Notes [1] Data for pumpage from the Upper Potomac hydrologic zone includes pumpage from Getty's one well in the middle Potomac zone (well #15).

Sources: University of Delaware Water Resources Center
Water Supply Branch, Delaware Department of Natural Resources and Environmental Control

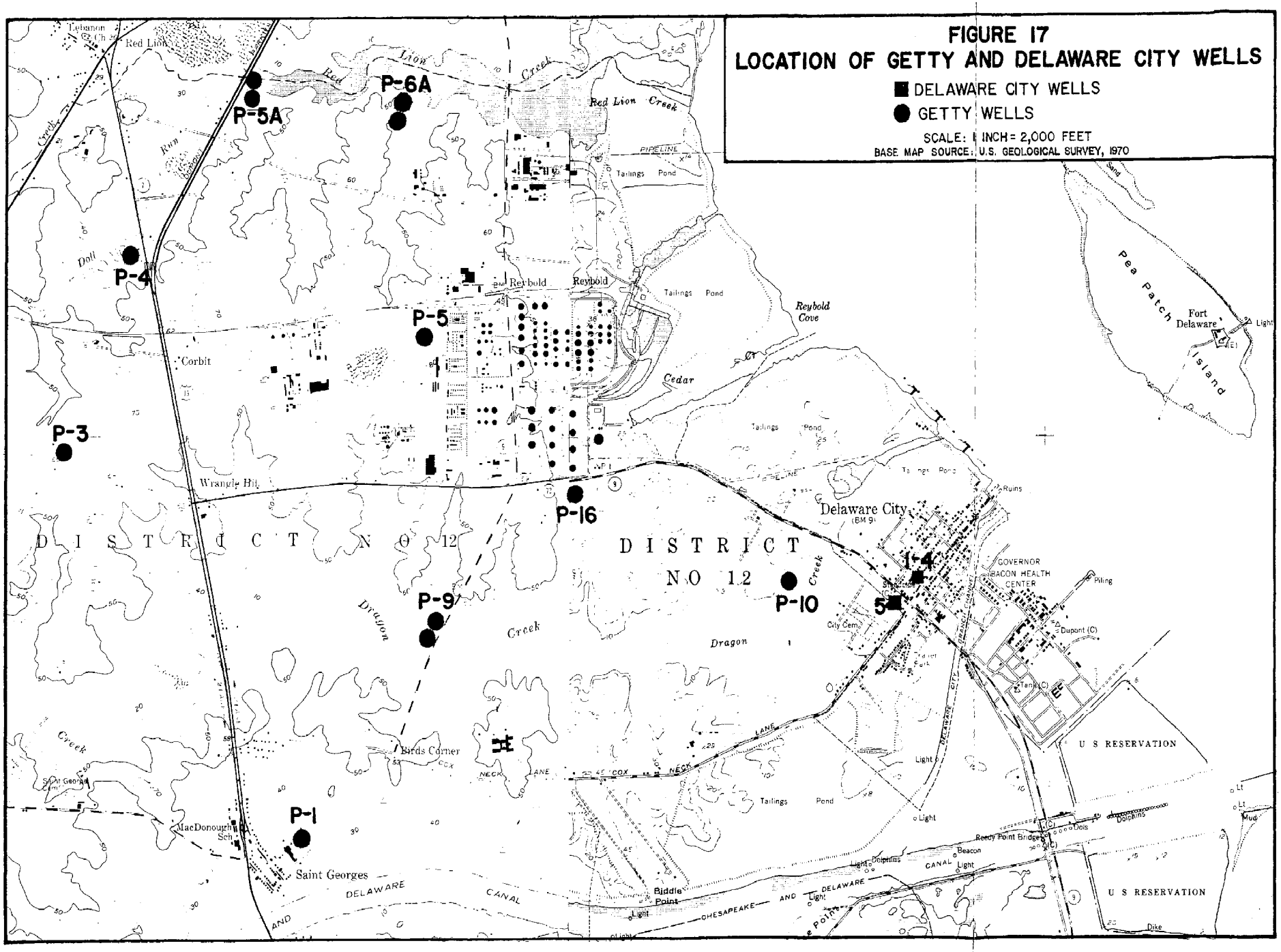


FIGURE 17
LOCATION OF GETTY AND DELAWARE CITY WELLS
DELAWARE CITY WELLS
GETTY WELLS
SCALE: 1 INCH = 2,000 FEET
BASE MAP SOURCE: U.S. GEOLOGICAL SURVEY, 1970
P-1
P-3
P-4
P-5
P-5A
P-6A
P-9
P-10
P-16
DISTRICT NO 12
DISTRICT NO 12
Red Lion Creek
Reybold
Reybold Cove
Cedar Cr
Tailings Pond
Corbit
Wrangle Hill
Delaware City
Fort Delaware
Pea Patch Island
Dragon Creek
Saint Georges
Birds Corner
MacDonough Sch
DELAWARE CANAL
CHESAPEAKE AND DELAWARE CANAL
Biddle Point
Reedy Point Bridge
U S RESERVATION
U S RESERVATION
GOVERNOR BACON HEALTH CENTER
City Cem
Dike

vicinity of Getty's well field was determined to be a 52-foot reduction in the static water level.[17] This has been explained by hydrologists as the result of the interrelationship between the aquifers of the lower, middle, and upper Potomac zones.

No analysis has been conducted on the reduction of water levels in the lower Potomac zone in the immediate vicinity of Delaware City's well field. A major explanation for this may be that Delaware City did not begin withdrawing water from the lower Potomac zone until 1961, and therefore was not monitored from the time that any effects of Getty's pumpage would have occurred. However, Sundstrom and Pickett have estimated the drawdown effects of Getty's level of pumpage, upon wells located at various distances from the center of Getty's well field.[18] Based on these estimates, a well drilled in the lower Potomac zone, 22,000 feet from the center of Getty's well field (as are Delaware City's wells), would experience an estimated reduction of 40 feet in water level.[19] The effects may actually be even greater at Delaware City, because of the proximity of Getty's most heavily-pumped wells to the town's well field. Getty well #P-10, which pumped an average of 700,000 + gallons per day between 1979 and 1981, is within one-half mile of Delaware City's well #5 (at the water tower). The influence of this well alone could be appreciable. Moreover, within two miles of Delaware City's well #5, Getty has three wells drilled in the lower Potomac zone, including wells #P-10, #P-16, and #P-9. Together, they provide a 1979-81 average of 1.94 MGD, or approximately 52 percent of the refinery's total groundwater withdrawal.[20]

The impact of Getty's groundwater usage on Delaware City's groundwater resources is a complex issue. A number of points must be considered together, toward determining this impact. These points are as follows:

1. Getty began pumping water from lower Potomac aquifers five years before Delaware City did. In effect, it could be argued that Delaware City has had an impact, albeit very minor, on Getty's groundwater resources, rather than the other way around.

2. Nevertheless, Getty's pumpage from Potomac aquifers has had a significant impact on groundwater levels in the area. While it has been determined that this pumpage does not threaten the availability of groundwater to other users, it does make withdrawal by others potentially more expensive. This is due to the additional depth from which the water must be lifted in a well, as a result of the reduction in the water level of the aquifer into which the well is drilled. While no specific computations are available which would reflect the extra costs to Delaware City, it can be hypothesized that additional energy to operate the city's well pumps has been necessitated by the lowered water levels.

3. The most recent analysis indicates that, to date, Getty's groundwater usage has not affected the quality of this resource. Any concern for the potential contamination of Potomac aquifers in the Delaware City area would have to be linked to salt water intrusion from the Delaware Estuary or to leachate migration from the Llangollen and Tybout's Corner landfills, as well as other landfills and disposal activities in the area. State water officials who are monitoring the salt water issue do not foresee any salt intrusion problem occurring for a number of decades. However, any potential problem with salt water intrusion is probably affected by the amount of water currently being withdrawn. As far as landfill-related contamination is concerned, in the event that leachate from Tybout's Corner (nearer to Delaware City than Llangollen) ever started showing up in lower Potomac aquifers in the area, Getty would be affected first. In fact, Getty's pumpage would tend to

act as a barrier, protecting the town's wells from contamination, by removing the contaminated water through the refinery's own wells. This effect would work in a manner similar to the recovery wells which have been drilled by the State DNREC around the Llangollen landfill, which have worked to contain the spread of contamination from the landfill.

4. Hydrologists and other water resource experts who have been contacted during the course of this study, have indicated that Getty's well system is wisely managed. This is primarily due to the company's practice of distributing its groundwater withdrawal to nine wells over a sizeable area, rather than withdrawing in heavy concentrations from a smaller number of wells located closer together.[21]

Surface Water Usage at the Refinery

Getty withdraws surface water from the Delaware River via Cedar Creek for the purpose of cooling the refinery's process equipment. This water, which is pumped at between 250 and 452 million gallons per day (MGD) through the refinery's Cooling Water Pump Station, is eventually returned to the Delaware River after a period of ponding, which allows it to cool to ambient temperatures.

It has been determined that this activity does not create any measurable adverse impacts on Delaware City water resources. This conclusion is based upon several factors, which include:

1. This water is already contaminated when it is withdrawn initially, owing to the upstream water quality of the Delaware River. Since most of it never comes into contact with refining processes, little or no additional contamination occurs. The portion which does come into contact with refining processes is sent through the refinery's waste water treatment plant. After being treated and cooled, it is discharged into the river.

2. Since this water is eventually returned to the river, there is no significant net extraction taking place. Therefore, Getty's surface water use does not contribute to the migration of the salt water line up the river, which is usually caused by depletion of water levels in the river.

3. A review of Getty's water discharge performance records indicates that the temperature of the cooling water is reduced to satisfactory levels, after its use and prior to being returned to the river. Therefore, no adverse impacts on the patterns of aquatic plant and animal life resulting from abnormal temperatures, can be expected.

Waste Water Treatment and Discharge at the Refinery

Since 1972, Getty has expended approximately $50 million to construct and upgrade its waste water treatment facilities and equipment.[22] Current facilities include:

* sour water stripping facility (to remove ammonia, sulfides, and other chemicals from waste water)
* oil-water separating facility
* activated sludge treatment facility (utilizing bacteria to consume dissolved organic material)
* aeration tanks, clarifiers, filters
* holding ponds

(A diagram of the refinery's waste water treatment system is shown in Figure 18).

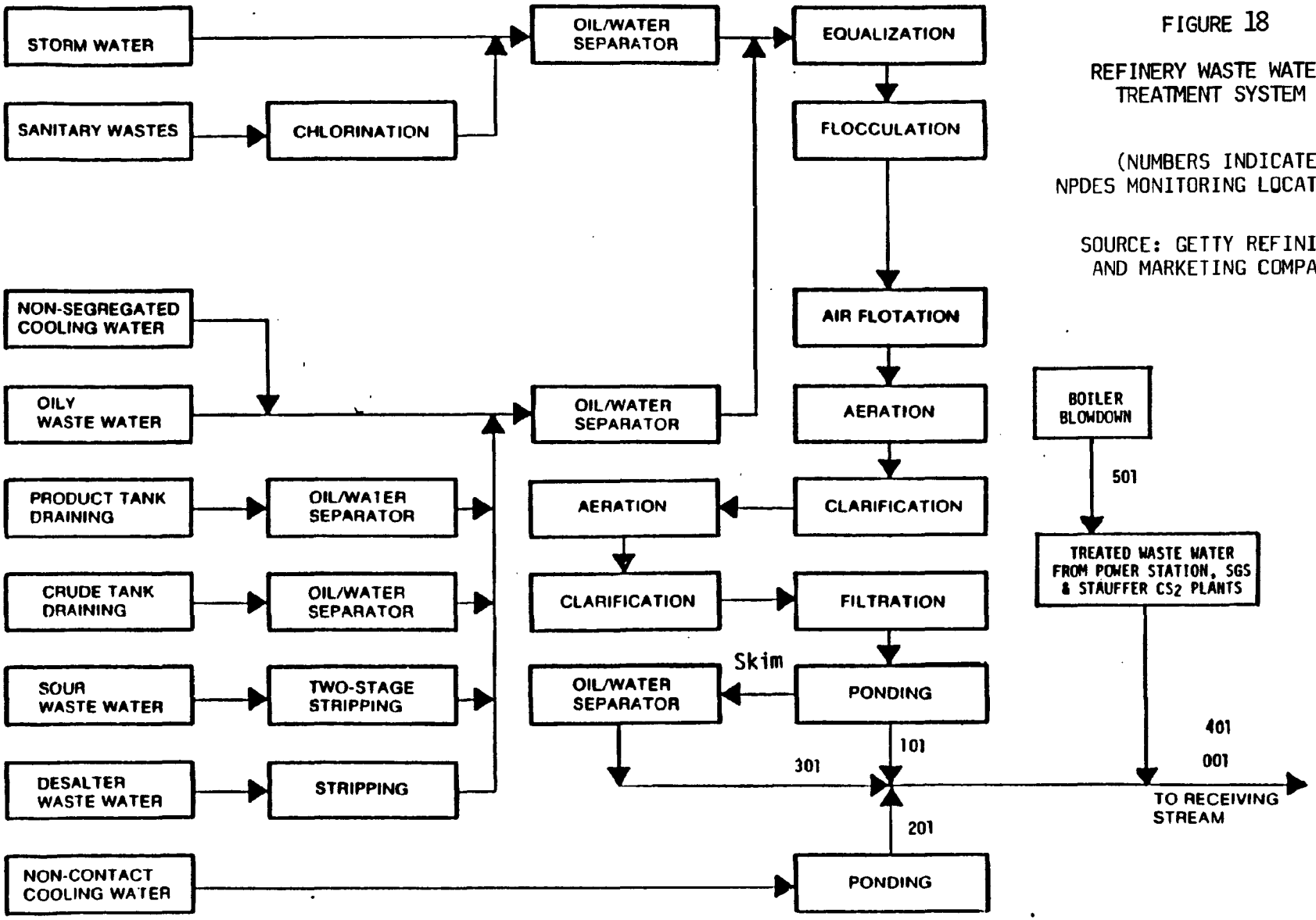


FIGURE 18

REFINERY WASTE WATER TREATMENT SYSTEM

(NUMBERS INDICATE NPDES MONITORING LOCATIONS)

SOURCE: GETTY REFINING AND MARKETING COMPANY

As a point-source discharger, Getty must obtain a permit from the State Department of Natural Resources and Environmental Control (DNREC), under the National Pollutant Discharge Elimination System (NPDES). This permit system, created by the Water Pollution Control Act Amendments of 1972, establishes standards and limits for the discharge of specific effluents from specific sources. In Delaware, the strictest of three different sets of standards is used in establishing the limits for Getty's discharges. These standards are generated by the U.S. Environmental Protection Agency (EPA), the Delaware River Basin Commission (DRBC), and the State DNREC.[23]

The permitting system was implemented in Delaware during the mid-1970's. Getty received its permit in March, 1977, with the understanding that it would be able to meet State and Federal discharge requirements by July 1, 1977. Getty was unable to meet several of the permit requirements, particularly those pertaining to ammonia and sulfide discharges, and consequently became in violation of the terms of its permit. As the result of a suit filed against the company by the State DNREC, a consent order was executed in Kent County Superior Court in November, 1977.[24] Based on the consent order, Getty agreed to construct an ammonia treatment project by July 1, 1980. Getty also agreed to make improvements to other aspects of its treatment program, in order to come into compliance with all remaining discharge limits, by November 1, 1980. Getty fulfilled its obligations by constructing the sour water stripping facility ($17 million), and making extensive improvements to the waste water treatment facility, both of which were accomplished during 1978-80. Since these improvements have been made, Getty has been consistent in its compliance with permitted waste water discharges, according to State water resource engineers who monitor the company's performance.[25]

Prior to the implementation of the National Pollutant Discharge Elimination System (NPDES) and subsequent state regulation of Getty's discharges, these discharges were regulated exclusively by the Delaware River Basin Commission (DRBC). The Commission adopted enforceable water quality standards in 1967, which required an 88 percent reduction in biochemical oxygen demand (BOD) created by municipal and industrial waste water discharges into the Delaware River Estuary.[26] In order to implement these standards, DRBC developed an allocation system which set a limit on the amount of BOD which each discharger could produce. (BOD is a broad measure of the amount of pollution in a body of water). The system required most dischargers to meet their allocation limit by 1975. Based on data collected by DRBC in 1968, Getty was the only one of 24 major dischargers into the Delaware River that was already in compliance with its allocated limits.[27]

It can therefore be concluded that, overall, Getty has performed relatively well on the quality of its waste water discharges, against both regional and state adopted standards, with the exception of the ammonia and related discharge problems discussed above. For the past two years, the refinery has been in full compliance with existing regulations under the NPDES. Table 12 indicates the water pollutants for which Getty is regulated, their potential impact on water quality, and the company's performance as of December, 1981.

TABLE 12

WATER POLLUTANTS FOR WHICH THE GETTY REFINERY IS REGULATED, AND COMPANY PERFORMANCE FOR DECEMBER, 1981

Name of Pollutant	Potential Impact on Water Quality	Concentration at Point of Final Discharge[1] Permitted	Observed
pH (acidity/alkalinity)	Aquatic life maintains a specific acid-alkaline balance. Any significant change in the pH of a body of water would have a serious effect on aquatic life. A pH change can effect the salinity of water and the amount of dissolved oxygen and other gases. An alkaline pH (pH between 7 and 14) makes ammonia more toxic to fish.	6.0 minimum 9.0 maximum	6.4 minimum 7.5 maximum
Temperature	Significant changes in the ambient water temperature as the result of a discharge can interfere with the metabolism and reproductive cycles of aquatic life forms. While fish, in particular, can adjust to higher temperatures, they may be drawn toward the warmer water, which is also more highly concentrated in other pollutants.	no established minimum temperature 110^{0}F maximum	59^{0}F minimum 67^{0}F maximum 63^{0}F average
Biochemical Oxygen Demand (BOD) — 5 day test	This broad indicator of water quality is a measure of the amount of oxygen-demanding organic matter in a discharge. Microorganisms use oxygen to oxidize biodegradable wastes. Therefore, oxygen is consumed which would otherwise be available for higher forms of marine life. If the oxygen demand exerted by the organic waste becomes too great, the marine life forms (particularly fish and other large species) may suffocate.	2.1 mg/l maximum 1.1 mg/l average	1.8 mg/l maximum 0.8 mg/l average
Total Organic Carbon (TOC)	This is another indicator of oxygen demand, although it does not directly measure oxygen demand. Instead, it measures the amount of carbon in organic waste. This carbon, when discharged, will require oxygen in order to be oxidized. This reaction produces carbon dioxide (CO_2), which becomes dissolved in water more readily than	4.5 mg/l maximum 2.5 mg/l average	3.8 mg/l maximum 1.7 mg/l average

TABLE 12, continued

Name of Pollutant	Potential Impact on Water Quality	Concentration at Point of Final Discharge[1] Permitted	Observed
TOC, Cont'd	oxygen does. CO_2, therefore, then displaces oxygen that is needed by marine life.		
Suspended Solids	Suspended solids are particles which may float, settle, or remain suspended in water. They are made up of clay and other silty matter, often mixed with oil and grease, sulfides, phenols, or various metals. If they settle on the river bed, they can render spawning grounds unrecognizable which are used by migratory fish such as salmon. They may also smother larvae and eggs. If they remain suspended and contain toxic pollutants, they will be consumed by marine species and may become widely-distributed throughout the food chain. Another impact of these solids remaining in suspension is the turbidity they create in the water, which is visually unpleasant, and also reduces the penetration of sunlight.	1.7 mg/l maximum 1.1 mg/l average	1.2 mg/l maximum 0.7 mg/l average
Oil and Grease	Hydrocarbons, which are often discharged as oil and grease, create impacts as a result of both their toxicity and the demand they place on dissolved oxygen supplies. Oil and grease which is discharged in refinery waste water effluent can be assorbed by suspended solid particles, as discussed earlier, thereby becoming widely-dispersed. Oil and grease also contain various hydrogen compounds, including hydrogen sulfide and ammonia, both of which are highly toxic. Research has indicated that when oil and grease enter the marine environment, they may remain for a long time rather than become biodegraded. Therefore, oil and grease discharges can tend to accumulate.	18 mg/l maximum 11 mg/l average	3 mg/l maximum 2 mg/l average
Phenols	Phenolic Coumpounds are actually aromatic hydrocarbons which are highly toxic to fish at a concentration of	0.015 mg/l maximum 0.009 mg/l average	0.0044 mg/l maximum 0.0013 mg/l average

TABLE 12, continued

Name of Pollutant	Potential Impact on Water Quality	Concentration at Point of Final Discharge[1] Permitted	Observed
Phenols, Cont'd	1 mg/1, and which also exert a high biochemical oxygen demand on the aquatic environment. Aromatic hydrocarbons, when consumed by humans, have been proven to be carcinogenic at higher concentrations.		
Ammonia (NH_3 as N)	Ammonia is a toxic nitrogen compound which also exerts a high chemical oxygen demand (C.O.D.). Some of its effects include the potential to suffocate fish, and its fertilizing properties, which can lead to algae blooms, thus causing the consumption of large amounts of dissolved oxygen. When this occurs, oxygen-using organisms, including fish, may smother.	1.1 mg/l maximum 0.5 mg/l average	0.4 mg/l maximum 0.2 mg/l average
Sulfides	Sulfides are high-soluable toxic compounds. Their toxicity is particularly high in slightly acidic water, in which case they appear as lethal hydrogen sulfide, which can be fatal to trout in concentrations as low as 0.05 mg/l. Sulfides also exert a chemical oxygen demand, thereby depleting the supply of dissolved oxygen available to marine life.	0.011 mg/l maximum 0.0044 mg/l average	0.003 mg/l maximum 0.0013 mg/l average
Bioassay	This is a test which measures the overall toxicity of discharged effluent. It is accomplished by determining the survival rate of micro organisms in the effluent. If the survival rate is too low, it not only indicates that the effluent is toxic, but it will destroy the reliability of tests which are used to determine biochemical oxygen demand.	50 percent minimum (survival in 50 percent effluent	80 percent minimum

Notes: 1. Data for some pollutants had to be adjusted to reflect the concentration at point of final discharge, since these pollutants are monitored at an earlier stage of the treatment cycle. The formula used was: concentration at monitoring station x $\frac{\text{flow at monitoring station}}{\text{flow at final discharge}}$

Sources: Water Resources Section, Delaware Department of Natural Resources and Environmental Control
Cracking Down: Oil Refining and Pollution Control (Council on Economic Priorities)

The Water Pollution Control Act Amendments of 1972 also included the requirement that industrial plants install the "best practicable control technology currently available" by 1977.[28] Presumably, whatever technology was available to any of Getty's competitors, would also be available to Getty. An analysis has been conducted by the Consultant, which compares Getty's waste water discharge performance in 1982 with the 1973 performance of eleven comparable refineries operated by the company's major competitors. Data for the eleven competitors' refineries was compiled and analyzed by the Council On Economic Priorities in a 1975 report on refinery pollution.[29] While a great deal of variation exists in the regulation of these refineries, they are all subject to the same Federal law (the Water Pollution Control Act Amendments of 1972), through which the National Pollutant Discharge Elimination System is implemented. Actually, because of the regulatory and equipment improvements which have occurred over the years between the two sets of data, Getty's 1982 performance can be expected to be far superior to the other refineries' 1973 performance.

Table 13 compares Getty's 1982 performance relative to the discharge of BOD content and oil and grease, with the 1973 performance of a selection of eleven of its competitors' refineries relative to these same pollutant measures. The refineries are all of comparable size, all treat their own waste water, and all discharge the treated water into major bodies of surface water. In each case, the data has been adjusted to reflect the amount of each pollutant in the intake water, before it has been used by the refinery. The resultant net discharges can therefore be identified as the direct contribution of each refinery. In addition, all discharge data has been standardized by adjusting for differences in the sizes of the refineries being compared, as measured by their crude oil processing capacities.

The comparison indicates that Getty's performance relative to BOD_5, a measure of water quality, is exemplary. In effect, the Delaware City refinery returns water to the Delaware River with considerably less BOD content than when the water was taken from the river, as indicated by the negative value of the data. However, the refinery discharges water into the river that has 60 percent more oil and grease than when it was taken in. Moreover, its performance relative to net oil and grease discharges is the second-worst of the refineries with which it was compared. Therefore, claims made by company officials that the refinery returns water to the river in a cleaner condition than when it was taken in, are not entirely correct.

TABLE 13
COMPARISON OF CAPACITY-ADJUSTED NET DISCHARGES (NET LBS/1,000 BBLS)
FOR SELECTED REFINERIES WITH 100-200 THOUSAND BARRELS PER DAY CAPACITIES

Refinery and Location	Capacity (1,000 BBLS per Day)	Most Recent System Improvements[1]	Receiving Waters	BOD5	Oil and Grease
Getty-1982 Data					
Delaware City, DE	140	1978-80	Delaware River	-60.52	12.64
Arco-1973 Data					
East Chicago, IN	126	1970	Lake Michigan	3.14	1.05
Philadelphia, PA	185	1973	Schuylkill River - Delaware River	2.99	1.84
Gulf-1973 Data					
Belle Chasse, LA	180.4	1972	Mississippi River	20.00	0.78
Philadelphia, PA	174	1973	Schuylkill River- Delaware River	37.50	5.73
Mobil-1973 Data					
Joliet, IL	175	1973	Des Plaines River	2.55	1.05
Paulsboro, NJ[2]	100	1967-74	Delaware River	204.00	258.00
Shell-1973 Data					
Martinez, CA	100	1972	Carquinez Strait- San Francisco Bay	18.50	3.66
Socal-1973 Data					
Richmond, CA	190	1972	San Pablo Canal- San Francisco Bay	34.60	10.90
Amoco-1973 Data					
Sugar Creek, MO	105	1973-74	Missouri River	22.80	12.50
Wood River, IL	107	1972	Mississippi River	0.39	-1.93
Texaco-1973 Data					
Convent, LA	145	1967	Mississippi River	6.61	0.99

Notes: [1] As of time of data collection
[2] Had no secondary treatment prior to discharge, at time of data collection

Sources: Council on Economic Priorities
Water Resources Section, Division of Environmental Control, DNREC
Getty Refining and Marketing Company

The impact of Getty's waste water treatment and discharge activities on Delaware City's water resources, is summarized with the following points:

1. Getty is currently in consistent compliance with all waste water discharge limits established for the refinery by the State DNREC through its NPDES permit, and has been in compliance for the past two years. Prior to that time, between 1977 and 1980, the refinery was in violation of its permit relative to ammonia and certain other discharges. A consent order entered into between Getty and DNREC in 1977 established a reasonable timetable for the correction of these problems. As a result, Getty spent $46 million in the constructon and improvement of treatment facilities during 1978-80.

2. Getty's performance in the discharge of organic oxygen-demanding wastes, as measured by the biochemical oxygen demand these wastes create, has been exemplary for the past 14 years or more. Data from December, 1981, indicates that Getty's waste water treatment system was actually removing an average of more than four tons of oxygen-demanding matter from the Delaware River each day. This has two implications for water quality in the Delaware River at Delaware City: it implies that levels of certain toxic wastes harmful to aquatic life are being reduced; and it implies that more oxygen is available for consumption by larger and more complex varieties of water life, such as fish.

3. At the same time, Getty's past and current discharges of certain other compounds have had a negative impact on the river. For instance, the refinery adds just under a ton of oil and grease to the river each day. Former Delaware Governor Russell W. Peterson, as Chairman of the White House Council on Environmental Quality, warned in 1975 of the long-term negative impact which oil pollution has on the marine food chain.[30] Moreover, Getty's discharge of ammonia, as measured by nonionic ammonia (NH_3), was in violation of State-enforced standards between 1977 and 1980, (no standards were enforced prior to 1977). Ammonia, particularly in the form of nonionic ammonia, has been identified as highly toxic in concentrations as low as one milligram per liter, and can have the effect of causing fish to suffocate.[31] Ammonia also causes a delayed biochemical oxygen demand which is not detected by currently-used BOD testing procedures.[32]

4. Getty's relative impact on water quality in the Delaware River must be considered in light of the extent of pollution already in the river upstream of the refinery's discharges. There are a total of approximately 90 municipal and industrial dischargers along the river. Nine or more of these have been identified as major petroleum or chemical industry installations, up-river from Getty, including five petroleum refineries. In addition, municipal waste water treatment plants operated by the City of Philadelphia and City of Camden, have been identified as the largest dischargers of oxygen-demanding wastes along the entire length of the river.

Solid Waste Disposal at the Refinery

Getty's landfill site, located on State Route 9 in a low area adjacent to the Diamond Shamrock property, has been licensed since 1968. The area consists of approximately 37 acres, and is up to 15 feet below ground surface in some places. Some of the wastes deposited at the landfill are composed of spent catalysts (used in the refining process to accelerate chemical reactions) and ceramic tower packings. These

two materials have been determined to be essentially inert, which means that they would tend to not dissolve in rain or ground water and create contaminated leachate, which would be harmful to water resources. The remaining bulk of wastes which are deposited at the landfill consist primarily of oily and tar-like sludges, which are organic and biodegradable. These solid wastes are brought to the landfill as the residue from the waste water treatment system.

Under the conditions of their current permit to operate the landfill, Getty is required to file quarterly reports on the composition of the wastes which are deposited at the landfill, along with data on the flow patterns of the water table in the Columbia formation, which flows 10-20 feet beneath the landfill. According to company engineers, the landfill is separated from the water table by an impermeable silty clay material, which has the effect of confining leachate to the fill area. Because of the fact that the leachate accumulates in the fill, rather than percolating into the water table, Getty must collect and remove it from the site. It has been reported that this leachate, after being removed, is pumped to the waste water treatment plant for treatment.[34]

As a result of spiraling costs for the disposal of liquid and solid wastes from refinery operations, and as a result of increasingly stringent Federal waste disposal regulations, Getty has developed a new approach to disposing of these wastes. It involves a technique known as "landfarming," and is being applied to the disposal of sludges which result from the waste water treatment processes. This approach, which is relatively innovative as applied to the disposal of refinery waste sludges, has been tested by the company at the site of the existing landfill. Essentially, the procedure involves the use of biodegradable sludge from the waste water treatment plant. This sludge has been activated by micro-organisms during the treatment process, which continue to break down and consume the organic matter. The sludge, at this point a "mushy" cake of 20-25 percent solids, is then transferred to the landfill site, where it is spread and allowed to drain. After it has dried, it is mixed with topsoil. The biodegradation continues to occur until the organic portion of the waste is completely consumed. Reportedly, the process is complete within one to one and a half months, at which time the waste material no longer contains oil and other biological wastes.

Getty is adequately pleased with the effectiveness of this new technique, so they are developing a 35-acre site which will be reserved for the use of the landfarming procedure. This site, located near the existing landfill, has been excavated and lined with clay. The activated sludge and soil mixture will then be applied to a depth of 18 inches. As portions of the site are reclaimed, it has been indicated that grass will be planted on the surface. Monitoring of the performance of the procedure will be accomplished by Getty and State solid waste engineers. The new procedure has been granted interim status through the Hazardous Waste Program of the U.S. Environmental Protection Agency, and full permit approval is pending.

The impact of Getty's existing landfill and proposed landfarming activities upon Delaware City's water resources, is summarized by the following points:

1. Until recently, Getty has disposed of refinery waste sludges by utilizing an on-site landfill and by shipping some of these wastes to other locations through contractual arrangements with other firms. This practice is generally acknowledged by experts in the field as more environmentally acceptable than discharging this material, as waste water, into a body of surface water (i.e., the Delaware River). While landfills have pollution potentialities of their own, primarily as a result of the leaching of contaminated rain and groundwater into nearby streams and aquifers, they can be constructed in such a manner as to avoid these problems. It appears

that Getty's landfill was developed in a way that has precluded the leaching problem, due to the fact that the landfill area is lined with an impermeable silty clay material. This material was placed in the ground by Getty and consists of dredged spoils materials which were deposited at the site during dredging operations in the Delaware River. In essence, the sludges which have been deposited in the landfill would otherwise have been discharged into the Delaware River, thereby contributing to the river's pollution. As the refinery's waste water treatment system has been upgraded to improve the quality of discharges into the river, more sludge has been generated, requiring alternative disposal.

2. The only concern about Getty's landfill, from a water pollution standpoint, applies not to the contamination potential of the sludge itself, but rather to the dredged spoils which were placed at the bottom of the landfill. It can be assumed that these spoils had a high salinity content, due to their removal from the Delaware River bed. They were placed on the site to a depth at which the soil content of the Columbia formation is composed of permeable sands. Based on the known level of the water table aquifer in this area, it is probable that chlorides (salts) from the spoils material have come into contact with the water table, thereby contaminating the aquifer in the area. This might partially explain why Getty started noticing a high salt content in water which they were withdrawing from wells in the Columbia formation, in 1961. However, since neither Getty nor Delaware City currently receives water from the water table aquifer of the Columbia formation, the impact of any salt water contamination would be nil.

3. With the commencement of Getty's new landfarming technique for the disposal of refinery waste sludges, the company will essentially be eliminating the possibility of pollution caused by these sludges. If the procedure works successfully, the effect will be similar to composting, which would have the result of actually rejuvenating the soil. According to research uncovered by the Consultant, this technique has been successfully applied to refinery waste sludges since 1974.[35]

4. Getty is in the process of completing a half-million dollar project to upgrade the system by which water that drains through the sludge disposal sites is collected and sent back to the waste water treatment facility. This practice will even further prevent the possibility of contaminated water leaching into groundwater supplies.

Marine Transfer Activities at the Refinery

Since opening in 1957, Getty has operated a marine terminal on their property along the Delaware River, for the purpose of receiving and shipping petroleum liquids. As part of this operation, three piers totaling 2,800 linear feet were constructed for the dockage of large tankers and smaller vessels, including barges. Large tankers, sometimes carrying in excess of 200,000 barrels of crude oil, dock at the terminal to unload. The crude oil is pumped from these vessels via pipeline, which transports the oil to storage facilities in the main area of the refinery. Other pipelines carry finished refinery products back to the marine terminal, where they are pumped onto barges for transportation to distribution outlets.

The potential impact of marine terminal activities relates to oil spillage into the Delaware River. Spillage could possibly result from three types of incidents: (1) leaks in the pipelines and hoses which connect to the tankers and barges; (2) the discharge of

bilge or ballast water from these vessels into the river; and (3) an accident, such as a collision or explosion involving a tanker or barge, which would cause cargo to escape into the water.

While no data has been officially compiled on oil spill events in Delaware, such data does exist for Maryland.[36] The implications of the data are illustrative of the seriousness of oil spillage at terminals. During Fiscal Year 1981, 15 spill events occurred at oil terminals in Maryland, representing less than one percent of the 2,496 spill events recorded for that year (14 other categories of sources accounted for the remaining events). However, that relatively miniscule number of events is reported to have accounted for 156,116 gallons, or 32 percent, of the total gallons spilled. Therefore, the relative impact of oil spillage at terminals, as opposed to other sources, is substantial.

Oil spills of varying sizes have periodically occurred at the Getty refinery's marine terminal throughout the years that it has operated. A substantial spill from the tanker San Sylvestre in 1959 created damage to nearby residents' properties, and presumably, damaged aquatic life in the river as well. The highest number of spills ever recorded at the refinery since State officials began monitoring them, occurred during 1973-74. The State Division of Environmental Control initiated enforcement actions, and the number of spill events was reduced sharply. It has been reported that more recently, only several spills of under 1,000 gallons each, occur per year.

Existing Federal laws, the most recent of which is the Comprehensive Environmental Responses, Compensaton, and Liability Act of 1980, place responsibility for the clean-up of spills upon the spiller. Getty utilizes the services of Seaways, a Delaware City-based firm which helps tie up the boats docking at the terminal and which is dispatched to contain any spills which occur.

Current oil spill clean-up technologies have advanced to the point where the bulk of any water-based oil spill can be readily contained and removed. Nevertheless, a portion of every spill will become dispersed or otherwise escape, and consequently is not recovered. Therefore,there is a potential for spilled oil to create adverse impacts upon water resources. In the event of a large spill, these impacts can be substantial. The consequences of such an event could have very damaging effects on aquatic life, including, for example, oysters, mussels, crabs, and other fish varieties, as well as waterfowl. Even minor spills can create problems, because it has been documented that oil is broken down very slowly in marine environments. Therefore, minor spills can have cumulative effects.

The impact of oil transfer activities at Getty's marine terminal, relative to water resources in Delaware City, is delineated by the following points:

1. Periodic spills of oil and related hydrocarbons have occurred at the marine terminal throughout the years that it has operated. In all probability, the spills have cumulatively resulted in the introduction of substantial amounts of unrecovered hydrocarbons into the Delaware River. The amount of damage these unrecovered hydrocarbons have caused to the life cycles of various species of marine life is not known. It is possible that marine life affected by hydrocarbons has been consumed by humans.

2. As a result of more stringent Federal and State regulations, and as a result of improved oil spill prevention and recovery technologies, the impact of Getty's marine transfer operations relative to oil spills, has diminished significantly. Getty has taken several key steps toward the prevention of oil spillage and toward the recovery of oil that is spilled. One step is the more

rigorous inspection of pipeline and hose connections which are used to transfer oil and related hydrocarbons between the refinery and marine vessels. Another step is the strengthening of transfer procedures. Thirdly, bilge and ballast water from tankers is now transferred to storage tanks, where it is subsequently pumped to the waste water treatment plant. Lastly, Getty has instituted a contractual arrangement with Seaways, a Delaware City firm, to recover oil which is spilled into the waters of the Delaware River.

3. The potential for occasional minor spills still exists. Moreover, the potential for a major spill caused by an accident or explosion involving a vessel docked at the terminal is real. This potential is substantiated by the January, 1975 tanker collision and explosion at the British Petroleum refinery in Marcus Hook; the March 1978 explosion of a jet fuel barge at Getty's terminal; the January, 1979 minor collision between the Pennsylvania Getty tanker and the USS Coronado in the Harbor at Norfolk, VA (while no oil spill occurred, the incident demonstrates the potential for accidents involving the company's tankers); and the January 1982 spill at the Texaco storage facility in Claymont, DE, in which 167,200 gallons of oil were spilled during the unloading of a barge. The Texaco incident resulted from a ruptured transfer pipeline. It has been estimated that a spill of this size, if it got into the river and was unattended for 12 hours, would leave a surface slick of 97,645 gallons, an additional 21,067 gallons would evaporate, and the remaining 48,488 gallons would become dispersed in the water.[38]

Underground Storage Activities at the Refinery

The Getty refinery includes one very large facility for the underground storage of propane (liquified petroleum gas). The facility is located in the area near the waste water treatment plant, approximately 1,000 feet from Getty water well #P-16. It operates on the principle of frozen earth as a means to contain the propane, which is stored at -50^{0}F, at approximately atmospheric pressure. This storage principle was pioneered by Phillips Petroleum Company in 1963 at the Phillips Wood Cross refinery near Salt Lake City, Utah.[39]

Getty's frozen earth storage facility, which is 3.7 times the capacity of the Phillips facility, consists of a cylindrical pit, approximately 165 feet in diameter, and 130 feet deep. The bottom of it appears to have been dug into the imperveous sandy silt of the Merchantville formation, which overlies the Potomac formation in the area of the site. A series of freezepipes have been positioned in a circle around the pit. A refrigerant is circulated through the freeze pipes from a large compressor unit. This process keeps the earth around the pit frozen to a thickness of 100 feet or more. Propane enters the chamber as a liquid, and while a portion of it boils off and evaporates, it is recaptured, condensed, and returned to the facility. The pit is covered by a steel dome, insulated by four inches of foam.

This storage technique is considered far safer and more economical than conventional above-ground storage under pressure, which has historically been troublesome, particularly in warm weather. It is maintained that even in the event that the compressors which keep the earth frozen were to break down, it would take months for the earth to thaw. The facility is also considered earthquake-proof, because whatever cracks might develop in the event of an earthquake, would be sealed by water seeping in from the water table and immediately freezing.

The only concern for the potential impact of this facility upon water resources,

relates to the possibility of a leak developing in the pit as the result of a crack in the frozen wall at a point not immediately accessible to groundwater. If a situation such as this were to occur, it is at least theoretically possible that propane could escape and vaporize, and subsequently work its way through the surrounding soil formations as a gas. If this happened, it would probably migrate in an upward direction, eventually reaching the Columbia formation water table aquifer, or else collecting in a pocket somewhere. If it migrated into the water table, there is reason to believe that it would, at least partially, dissolve in the water.[40] It would then be carried into nearby streams, following the discharge patterns of the water table. The consequences of this hypothetical situation would have to do with the contamination of surface waters by these hydrocarbons, which could be toxic to aquatic life.

Very little is known by geologists, chemical engineers, and other experts about the potential behavior of petroleum gases and aromatic hydrocarbons, when they are released into the ground. One incident, which may bear some relationship to Getty's underground storage activities, involved the undergound storage of butane and benzene at the Sun Oil refinery in Marcus Hook, Pennsylvania. These two products, similar in molecular weight to propane, were stored at the Sun refinery in a network of underground granite caverns. Apparently as the result of the overfill or overpressurization of the caverns, hydrocarbons began leaking out of the caverns, through the surrounding soils, and into the basements of nearby homes.[41] The Borough of Marcus Hook filed suit against the refinery, seeking to enjoin the company from operating the storage facility. In addition, homeowners who had to be evacuated from their homes as a result of the seepage of these gases, filed a class action suit to obtain compensation for loss of the use of their homes. While the injunction suit did not result in an actual injunction, the refinery was forced to install a number of monitoring devices and institute other precautionary measures, in order to comply with a consent order executed in January 1979.[42]

The potential impact of Getty's frozen earth storage activities upon groundwater and surface water resources is a highly-speculative question. However, based on the Sun Oil incident in Marcus Hook, there is evidence for the potential of petroleum-based gases to leak from underground storage containments, and to migrate through the ground. If this were to occur, the possibility of seepage into the water table aquifer, which runs at a higher altitude than the bulk of the earth pit, does exist but is speculative. As mentioned previously, the water table aquifer in the Columbia formation is not used as a source of water in the Delaware City area. Therefore, any potentiality of gas seepage would pose more of a hazard to aquatic life than to humans, except to the extent that any affected aquatic organisms were consumed by humans. To summarize, past experience indicates that careful monitoring and maintenance of the frozen earth storage will minimize the risk of any leakage from the pit.

CONCLUSIONS

The foregoing discussion of the past, currently existing, or potential impacts of Getty refinery activities upon Delaware City's groundwater and surface water resources, has been very complex and has involved the consideration of numerous factors. In an effort to summarize the findings of the preceding analysis, Table 14 has been developed to present the key points.

TABLE 14

SUMMARY OF THE IMPACTS OF REFINERY ACTIVITIES
UPON DELAWARE CITY'S WATER RESOURCES

Refinery Activity	Existing or Potential Impacts	Consequences of Impacts	Status of Impacts
1. Groundwater Usage-upper, middle, and lower hydrologic zones of the Potomac formation	Although Getty has been pumping water from these aquifers five years longer than Delaware City has, the effect has been to create a "drawdown" (lowering) of the water levels in these aquifers. In addition, because of the high rate at which the refinery withdraws this water (1979-81 average of 3.75 million gallons per day), it might be accelerating the migration of salt water and other contaminants toward these aquifers.	The consequence for Delaware City of water level drawdowns caused by Getty's pumpage relates to the additional energy required by the city to pump water the additional height. The problem involving the possible migration of contaminants toward the (city's) water supplies would affect the quality of domestic water service.	The drawdown impact has been more or less permanent since the refinery began withdrawing water from Potomac aquifers. The impact associated with the acceleration of salt water and other contaminants migrating toward Delaware City, has not affected the town yet and is not expected to for a number of decades, if at all.
2. Surface Water Usage—Delaware River via Cedar Creek	This activity has no identifiable existing or potential negative impacts on Delaware City's surface water resources. From a water supply standpoint, virtually all of the water Getty draws from the river is subsequently returned. From a water quality standpoint, this water is improved by the refinery in most respects prior to being returned.	Getty's use of surface water from the Delaware River has no identifiable negative consequences. The return of this water to the river after its use has certain positive consequences, which are described below under waste water treatment and discharge activities.	Not Applicable.

TABLE 14, Continued

Refinery Activity	Existing or Potential Impacts	Consequences of Impacts	Status of Impacts
3. Waste Water Treatment and Discharge—Delaware River	The treatment of refinery waste water has improved markedly over the years since the refinery opened. This has had the effect of reducing the extent of negative impacts caused by the discharge of waste water into the Delaware River. The refinery has consistently performed very well relative to the discharge of oxygen-demanding effluents. However, performance relative to the discharges of oil and grease, ammonia, and certain other compounds, has not been as noteworthy. Nevertheless, the refinery's waste water treatment facility is effectively responsible for returning water to the river with less BOD content than the water contained when withdrawn from the river at the refinery's intake facility.	Getty's waste water discharges have both positive and negative consequences for the Delaware River and its related plant and animal life. While the company's performance relative to oxygen-demanding wastes actually improves the river's water quality, the discharge of oil and grease and the past discharge of ammonia and other compounds at excessive levels, has degraded the water quality. In both cases, the respiratory, feeding, and reproductive processes of aquatic life in the area are affected.	As a result of the increasingly stringent regulations which are applied to Getty's discharged effluent, the quality of this effluent has kept improving. Presumably, negative impacts occurred much more extensively prior to the enforcement of these regulations, especially prior to the early 1970's. Since 1980, Getty has been in consistent compliance with all discharge limits which have been implemented by the State Department of Natural Resources and Environmental Control, under the National Pollutant Discharge Elimination System (NPDES).
4. Solid Waste Disposal—landfill and landfarm locations	Getty's practice of landfilling the sludges which come from the waste water treatment facility is more environmentally sound than discharging these wastes into the Delaware River. The production of sludge requiring land disposal is directly related to the removal of wastes from the refinery's waste water. Getty has operated a landfill for a number of years, at which (continue with next page)	Since Getty's disposal of refinery wastes on land is directly related to not discharging them into the river, there have been positive consequences for the quality of water in the river. Moreover, Getty's land disposal techniques avoid the contamination of groundwater supplies.	Getty's techniques for the land disposal of refinery wastes have historically been environmentally acceptable. With the landfarming technique, currently being put into operation, land disposal activities will be even more sound.

TABLE 14, Continued

Refinery Activity	Existing or Potential Impacts	Consequences of Impacts	Status of Impacts
4. Solid Waste Disposal, Continued	the sludge has been disposed. The landfill, as best as can be determined, is well-sealed, thus preventing rain and groundwater from leaching through the site and contaminating groundwater supplies. The only potentially negative impact of this operation stems from the fact that the landfill is lined with dredged spoils from the Delaware River, which probably have a high salt content. It is quite possible (though not proven) that the water table aquifer of the Columbia formation has come into contact with these salts, thus contaminating these waters. However, the water table is no longer used as a source of water in the area, and any salt water would tend to drain into nearby streams, thereby returning to the Delaware River. Getty's new procedure of farming the sludge, by turning it into the soil, is expected to virtually eliminate the toxic content of the sludge. Getty's land disposal of refinery wastes is not seen as having any significant negative impact upon water resources, and actually represents a positive impact, by not allowing these wastes to be discharged into the Delaware River.		

TABLE 14, Continued

Refinery Activity	Existing or Potential Impacts	Consequences of Impacts	Status of Impacts
5. Marine Transfer of Petroleum liquids—Marine Terminal	Getty's marine transfer activities have resulted in periodic oil spill incidents throughout the years since the refinery opened. Moreover, the potential exists for a collision or explosion involving a vessel docked at the terminal, which might result in a massive spill. While current clean-up technologies enable the recovery of the bulk of any spilled product, a portion will become absorbed by the marine environment. These technologies have not been employed until relatively recently. Therefore, these activities have resulted in negative impacts on the quality of the Delaware River, although the extent of these impacts is probably not large.	The presence of oil and grease in bodies of water affects the respiratory, feeding, and reproductive processes of aquatic life forms. Some of the larger species of animal life, such as crabs, oysters, mussels, and other fish varieties are ultimately consumed by humans.	Getty has instituted a number of improvements and precautionary measures at the marine terminal. Consequently, the frequency and extent of oil spills has greatly decreased in recent years. However, the potential still exists for a collision or explosion at the terminal, which could have catastrophic results.
6. Underground Storage—Frozen Earth Storage Facility	Use of the frozen earth underground storage facility could have the potential impact, under extreme circumstances, of contaminating the water table aquifer of the Columbia formation, which runs at a shallow depth beneath the ground surface. If this were to happen, the contaminated water would probably drain into nearby streams and eventually reach the Delaware River. This would result in a negative impact on water quality of the Delaware River, but probably would not affect domestic water supplies.	If the river was to become affected by the contamination of propane seepage, it could adversely affect the life cycles of aquatic plant and animal life forms.	Current conditions of the operation of the frozen earth storage facility have not produced any of the aforementioned impacts. These impacts exist only as potentialities, and are the object of speculation.

RECOMMENDATIONS

In most cases, areas of past, current, or potential impact upon Delaware City's water resources as affected by Getty operations, are being carefully monitored and regulated by the DNREC. Therefore, it is not recommended that Delaware City pursue the implementation of its own regulatory mechanisms, but rather, become more directly involved in the established regulatory arrangement. This can be accomplished by establishing direct relations with officials of the DNREC Water Supply Branch, in order to be kept informed of proposed changes in Getty's water resource usage which may affect water supply or quality in the community. Direct relations should also be established with the State Environmental Protection Officer assigned to the area, in order to be more informed of any violations of water pollution standards and regulations committed by the refinery.

It is further highly recommended that the Mayor and Council of Delaware City arrange to have a comprehensive set of tests performed on the City's municipal water supply, in order to analyze the chemical content of this water. The purpose of this testing would be two-fold: (1) to determine if contaminants harmful for human consumption are currently present in the water; and (2) to establish a baseline of information, so that periodic tests in the future can be compared in order to detect undesirable changes or trends. This chemical analysis should be set up to test for a wide range of chemical contaminants, such as those identified in the vicinity of the Llangolen and Tybout's Corner landfills, particularly heavy metals and PCB's (polychlorinated Biphenyls). In addition, testing should be done for lead and chlorides. This recommended level of testing far exceeds the periodic tests which are conducted by the Division of Public Health as part of the regular monitoring of the City's water supply. In light of the potential water quality problems which have been discussed in this chapter, it is felt that any minor expense involved with the conduct of these tests, is a worthwhile investment toward the protection of the community's health, safety, and welfare.

In order to accomplish the recommended level of testing, the City may have to hire a private laboratory. However, the Technical Services Section of the State Division of Environmental Control should be contacted first, to determine if the testing can be done by this governmental unit. The person to contact is Mr. Harry W. Otto of the Technical Services Section.

CHAPTER NOTES

1 R. W. Sundstrom and T. E. Pickett, The Availability of Ground Water in New Castle County Delaware (Water Resources Center, University of Delaware, July 1971), p. 122.

2 Ibid, p. 124.

3 Based on interviews with Bruce Kraeuter, Water Resources Agency for New Castle County (August 4, 1982), and Ken Woodruff, Delaware Geological Survey, University of Delaware (August 10, 1982).

4 Sundstrom and Pickett, pp. 14-17.

5 Douglas Frick and Leslie Shaffer, Assessment of the Availability, Utilization, and Contamination of Water Resources in New Castle County, Delaware (Office of Water and Sewer Management, New Castle County), p. 77.

6 Water Supply Branch, Delaware Department of Natural Resources and Environmental Control, Public Water Systems in Delaware (DNREC, 1978), section on Delaware City.

7 Frick and Shaffer, p. 97.

8 Ibid, pp. 8-12.

9 Based on interviews with Michael Apgar, Delaware Department of Natural Resources and Environmental Control (April 1982); Bruce Kraeuter, Water Resources Agency for New Castle County (August 1982) and Ken Woodruff, Delaware Geological Survey (August 1982).

10 Nancy Kesler, "Shelly Farms Dump Added to Nation's 'Worst' List," News Journal (News Journal Company, Saturday, July 24, 1982), pp. 1 and 4.

11 Delaware River Basin Commission, Water Quality of the Delaware River, 1979: A Status Report (DRBC, March 12, 1980), p. 3, in DNREC, Delaware 1980 Water Quality Inventory (DNREC, July 1980), Addendum I.

12 Frick and Shaffer, pp. 97-100.

13 Ibid, p. 95

14 DNREC, Public Water Systems in Delaware.

15 Sundstrom and Pickett, pp. 82-88.

16 Ibid, pp. 56 and 82-88.

17 Ibid.

18 Ibid, p. 90.

19 Ibid.

[20] Michael A. Apgar and Bijay Panigrahi, Estimated Impacts of Brackish Water from the Delaware Estuary on the Quality of Ground Water and Ground Water-Derived Water Supplies from the Potomac Aquifer in New Castle County Delaware (Delaware DNREC Staff Paper, February 16, 1982), p. 9.

[21] Interview with Ken Woodruff (August 1982).

[22] Getty Oil Company, Annual Report to the Stockholders (1975-79).

[23] Interviews with Roy Parikh and Paul Jones, Water Resources Section, Delaware DNREC (April 23, 1982).

[24] Olney vs. Getty Refining and Marketing Company, Consent Order (Delaware Superior Court, Kent County, Civil Action No. 429, November 29, 1977).

[25] Interview with Roy Parikh (April 1982).

[26] Council on Environmental Quality, The Delaware River Basin: An Environmental Assessment of Three Centuries of Change (CEQ, August 1975), p. 12.

[27] Ibid, p. 13.

[28] Federal Water Pollution Control Act Amendments of 1972, 33 U. S. Code, Sec. 1151 et seq., in Delaware DNREC, State of Delaware Water Quality Management Plan (DNREC, 1975).

[29] Gregg Kerlin and Daniel Rabovsky, Cracking Down: Oil Refining and Pollution Control (Council on Economic Priorities, 1975).

[30] Ibid, p. 104.

[31] Ibid, p. 106.

[32] Ibid, p. 101.

[33] Council on Environmental Quality, The Delaware River Basin: An Environmental Assessment of Three Centuries of Change, p. 13.

[34] Interview with Bill Tansey, Environmental Engineer, Getty Refining and Marketing Company (August 23, 1982).

[35] Richard W. James, Sewage Sludge Treatment and Disposal (Noyes Data Corporation, 1976), pp. 312-313.

[36] Maryland Water Resources Administration, Summary of Spill Events in Maryland (Maryland Department of Natural Resources, June 30, 1981).

[37] Kerlin and Rabovsky, p. 105.

[38] Robert B. Biggs, Decisions for Delaware: Sea Grant Looks at Oil Spills (College of Marine Studies, University of Delaware, August 1977), p. 2.

[39] "Frozen Pit in Utah Will Store 135,000 Barrels of Propane," Oil and Gas Journal (OGJ, July 29, 1963), pp. 100-101.

[40] This description of what might occur in the event of a leak in the storage compartment is based on a conversation with Ken Woodruff, Delaware Geological Survey (August 1982).

[41] Interview with Francis A. Ferrara, Esq., Kasaab, Cherry, Archbald (April 1982).

[42] Borough of Marcus Hook vs. Sun Oil Company of Pennsylvania, Adjudication and Final Decree (Court of Common Pleas of Delaware County, Pennsylvania, No. 78-6342, January 24, 1979).

CHAPTER 7

VISUAL QUALITY IMPACT ANALYSIS

INTRODUCTION

The visual, or aesthetic, quality of a landscape scene or set of scenes is an important aspect of the quality of life of a place. The visual landscape is also being increasingly recognized as an important component of environmental quality. A growing number of actions by courts, legislative bodies, and citizen groups reflect the premise that outdoor aesthetics influence human well-being and that attractive visual landscapes yield benefits.[1] This conviction has been applied with special emphasis in recent years upon coastal zone locations. The Coastal Zone Management Act of 1972 specifically cites aesthetic values of the coastal zone among those coastal resources to be managed and protected. The federal intent is clear, both through legislative action and executive directives, that the states and territories should direct adequate attention to assessing, and ultimately, to managing aesthetic resources.[2] Consequently, environmental analysts have devoted a substantial amount of attention to the assessment of the visual environment, particularly the coastal visual environment. Visual "access" to coastal areas is accorded the same importance as physical access in coastal management guidelines. One survey taken of residents of a coastal community indicated that sentiment in favor of protecting the scenic value of the shoreline ran strong.[3]

A visual quality analysis was conducted in Delaware City during July, 1982. The purpose of this analysis was to determine the extent to which the town's current visual quality is affected by the presence of the Getty refinery, and its related facilities. After explaining the criteria which were used by the Consultant in undertaking this analysis, the findings and conclusions are presented in the following pages. Of particular importance with regard to the aesthetic characteristics of man-made features in coastal areas is the incidence of visual elements which may distract the eye and disrupt the visual integrity of a coastal landscape.[4] As applied to the analysis of Delaware City, this means that for each vista analyzed, the two prime considerations are:

1. the amount and degree (if any) of visual intrusions on the landscape scene caused by the refinery operatons; and

2. the degree of visual harmony or disharmony created by the visible portion of the refinery operations.

The other aspect of the visual analysis will be an historical perspective. The purpose of this will be to determine the ways in which the presence of the refinery has changed the visual character of Delaware City relative to its pre-1955 appearance.

HISTORICAL PERSPECTIVE ON DELAWARE CITY'S VISUAL QUALITY

A review of the history of Delaware City suggests that the visual character of the center of the town itself has changed very little during recent decades. This impression is verified by noting the age of most of the architectural features of the town. Therefore, the only major change in the visual character of the town has been the addition of the Getty refinery complex at the edge of town in the 1950's. In addition to altering the scenic panorama at the tip of Battery Park and obstructing some residents' views of the Delaware River, the refinery has made a major impact upon the image of the town which one obtains upon approaching. Along the major routes leading to the town, the visual environment is dominated by the refinery complex on both the north, west and south, creating a heavy industry impression which does not truly reflect the town's character.

Before 1955, the land on which the refinery is situated was primarily farmland. In

fact, much of the foliage on the property has grown since the origin of the refinery. It blocks the view of the refinery from the town and camouflages the dredged materials fill areas. Thus, the town residents formerly had a broad, panoramic vista looking westward from the center of town, which consisted of a pleasant rural landscape.

In addition, several historically and architecturally significant structures - including the Reybold Mansion, Lexington, which had most recently housed King's College, and the Marl Dale House - have been destroyed since the inception of the refinery operations. The elimination of these structures from the landscape was not met with great appreciation on the part of some long-time area residents. For instance, a column published in the New Castle Gazette on May 12, 1961,[5] expresses these reactions dramatically. "A drive down River on Hamburg Road from here used to be a great pleasure," wrote Nick McIntire, the columnist. "Now it is a rather depressing ride. So many of the old places are gone that we associated with memories of earlier days and the encroachment of heavy industry is altering the entire character of the countryside." "This used to be a fine section of farmland with pleasant homes, some quite old and historical. . .". Mr. McIntire also contended that, ". . . Delaware City looks rather dingy and unkempt . . .". A similar observation was made by former Governor and U.S. Senator C. Douglass Buck, who claimed, in 1958, "In less than a year and a half, the countryside in the vicinity of the refinery has changed from a clean, attractive and peaceful farming and residential community, to a smelly unattractive section of the state."[6]

Although these are the views of two individuals only, it is worth noting that the Getty Refinery has had a significant historical impact upon the visual character of the area surrounding Delaware City.

ANALYSIS OF THE CURRENT VISUAL QUALITY OF DELAWARE CITY

The visual character of Delaware City has been evaluated and itemized from numerous vantage points throughout the town, and from entrance routes into the town. The results of this investigation are provided in Table 15. The numbered vantage points are keyed to a map of the town and its environs (see Figure 19), and are photographically represented in Plate 3.

TABLE 15

VISUAL ANALYSIS INVENTORY
DELAWARE CITY

Vantage Point	Observations
1. Approaching Delaware City from the south, along Route 9.	The vistas along the entrance routes to Delaware City have been examined for the obvious reason that these scenes provide the initial image to anyone entering the town. Driving toward the town from the south across the Reedy Point Bridge, a full view of the entire refinery complex presents itself, including the storage tanks. The refinery is distinct in this panorama. In fact, the town itself is completely obscured by trees and

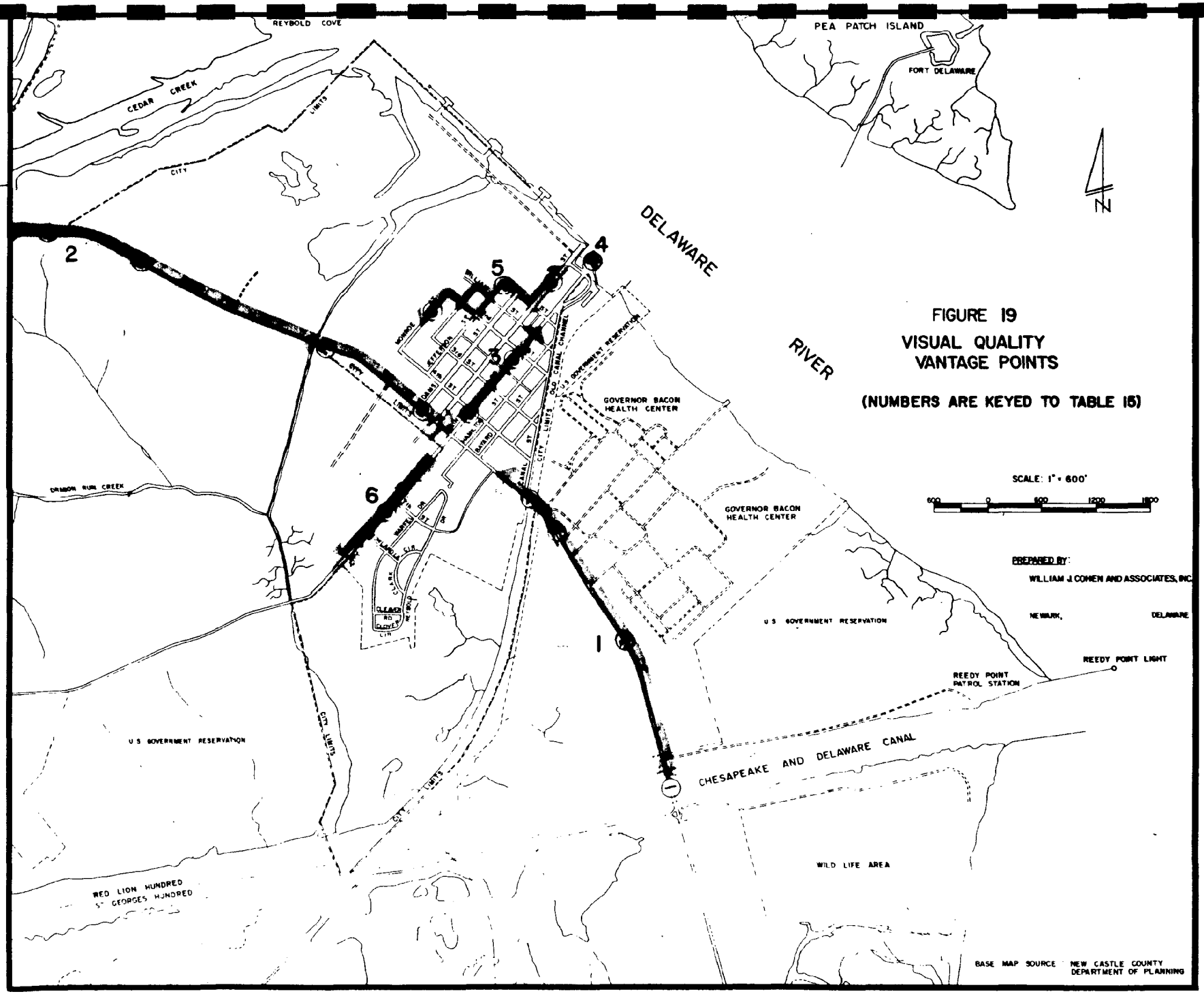

REYBOLD COVE
CEDAR CREEK
CITY LIMITS
PEA PATCH ISLAND
FORT DELAWARE
N
DELAWARE RIVER
FIGURE 19
VISUAL QUALITY
VANTAGE POINTS
(NUMBERS ARE KEYED TO TABLE 15)
SCALE: 1" = 600'
600 0 600 1200 1800
PREPARED BY:
WILLIAM J COHEN AND ASSOCIATES, INC.
NEWARK, DELAWARE
GOVERNOR BACON HEALTH CENTER
U S GOVERNMENT RESERVATION
REEDY POINT LIGHT
REEDY POINT PATROL STATION
CHESAPEAKE AND DELAWARE CANAL
WILD LIFE AREA
RED LION HUNDRED
ST GEORGES HUNDRED
DRAWBRIDGE
BASE MAP SOURCE NEW CASTLE COUNTY DEPARTMENT OF PLANNING

TABLE 15, Continued

Vantage Point	Observations
	other greenery. At the northern end of Reedy Point Bridge, the refinery ceases to be visible. Proceeding across the old canal bridge, looking northward into Delaware City along Fifth Street, one is presented with a much more pleasing view of a broad, tree-lined residential street.
2. Approaching Delaware City from the northwest, along Wrangle Hill Road	Approaching Delaware City on Route 72- Wrangle Hill Road from the northwest, the ground-level view is the only view available. Naturally, the refinery dominates the vista on the north side of Wrangle Hill Road, from Route 13 until the Delaware City line. After passing the refinery proper, and proceeding toward the town, one is still confronted with the barbed wire, chain-link fence and the large pipeline network which runs adjacent to it, both of which are incompatible with the rural greenery which is the dominant landscape feature. Upon entering Delaware City, the view of the fence and pipeline recedes and gives way to tall trees and impressive homes, particularly on the east side of the road, where the Chelsea estate is located. Closer to town two service stations with protruding signs appear, and are incompatible with the remainder of the vista. This area is the least visually pleasing portion of the incorporated area of Delaware City.
3. Clinton Street at Town Hall, heading toward the waterfront	The center of Delaware City as viewed from Town Hall presents a serene, residential panaroma. The refinery is not visible at all. The view on Clinton Street looking east consists of extensive greenery among homes harmonious in architectural quality, punctuated by two church spires. There are a few intrusions, such as utility poles. The view looking west on Clinton Street is similar, although the water tower presents a very conspicuous intrusion on the scene. From the second floor of Town Hall, the view consists of the tree-tops and upper floors of homes along the street. From this vantage point, the refinery is not visible. Traveling east on Clinton Street, toward the waterfront, the view consists of a row of small shops facing older homes across the street, which are aesthetically pleasing and harmonious

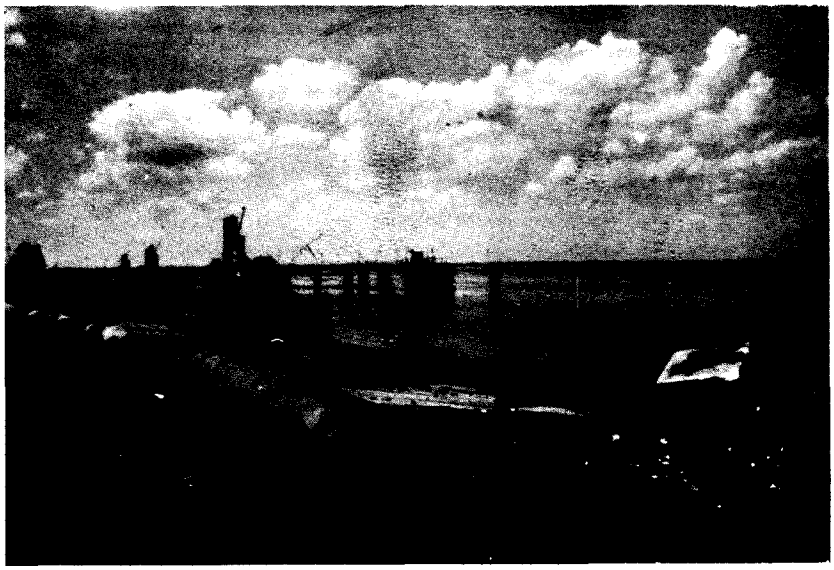
TABLE 15, Continued

Vantage Point	Observations
	with the small-town historic image which is characteristic of Delaware City. The vista is basically homogenous, with few specific focal points.
4. The State Park and Battery Park at the Waterfront	The State Park and Battery Park are attractively and modestly landscaped, and blend positively with the business district on the north side of Clinton Street. Looking east from the tip of the waterfront, the vista focuses on the Delaware River, Pea Patch Island, and the New Jersey shoreline. Pea Patch Island and the New Jersey shoreline beyond it are characterized by greenery with no large, vivid structures other than Fort Delaware, which blends harmoniously. However, the very tall Delmarva Power Company power lines which traverse the river to the northeast and the southeast are very distractive to the panorama. The vista to the south consists of the Delaware side of the Delaware River shoreline. It is primarily occupied by high, overgrown marsh vegetation which is growing on the U.S. Government Reservation, immediately below the old canal. This vegetation dominates the view of the shoreline south of Delaware City, except for two radio towers in the distance. The view from the waterfront into town is attractive. The vista includes the park area itself, with its many trees, benches, and gazebo. This scene connects smoothly with the eastern end of Clinton Street, composed of a row of commercial establishments leading westward along each side of the street. Many examples of well-preserved early and mid-Ninetenth Century architecture line the street, dominated by the Old Canal Inn and Sterlings Tavern. This panorama provides a very positive image of the Town. To the north lies the Getty marine terminal and the spoils material area to the northwest. The spoils area, which is high, consists of green wetland vegetation which almost completely obliterates the refinery complex from view. Only the tops of several tall smoke stacks and towers are visible at the horizon, and these do not significantly intrude on the overall character of the waterfront panorama. The marine terminal itself is

PLATE 3

VISUAL IMPACTS
DELAWARE CITY WATERFRONT

VANTAGE POINT 4
BATTERY PARK



VANTAGE POINT 4
BABY BEACH

TABLE 15, Continued

Vantage Point		Observations
		dominated by a cyclone fence, the security buildings, one storage tank, three piers and tall cranes, and numerous utility poles. The character of the view is clearly industrial, but the greenery of the Delaware River shoreline beyond softens the impact and the view is not severely unattractive.
5.	Residential neighborhood north of Clinton Street bordering Getty's property	The visual analysis conducted in the residential area bounded by Clinton Street, Monroe Street, Front Street, and Fourth Street revealed quiet, tree-lined streets and attractive older homes. Dense, high vegetation on the adjoining Getty property eliminates any view of the refinery, except that the tip of one smoke stack is visible from Madison Street. Even the two-story houses appear to be sheltered from viewing the refinery by an abudance of tall trees, including evergreens. It should also be noted that the height of the spoils material area obstructs the view of the Delaware River for most of these residents. However, this area is well-vegetated and does not seriously detract from the quality of the visual environment in this neighborhood. The fence surrounding the refinery property is visible only when looking east at Washington and Front Streets. The view looking east from Washington Street, between Harbor and Front Streets, includes the tall Delmarva Power lines in the river, two dilapidated buildings and unruly dense marsh vegetation which obstructs the view of the waterfront.
6.	West Clinton Street and Harbor Estates	The visual scene on Clinton Street west of Route 9 (Fifth Street) consists mainly of greenery surrounding residential dwellings. The eastward view is dominated by the City's Water Tower. Looking north, while proceeding west, first the refinery smoke stacks, and then the upper part of the refinery itself, become visible above the tree-line, beginning about 0.3-mile west of Fifth Street. This portion of the refinery is in plain view from the backs of homes on the north side of Clinton Street and from some homes on the south side, which sit at a higher elevation. However, the refinery does not dominate this vista, and while the industrial facilities are not in harmony with the overall

TABLE 15, Continued

Vantage Point	Observations
	nature of the panorama, they do not appear to seriously impair it. Within Harbor Estates, along Warfel Drive, the high grass embankment along the north edge of the development prevents a visual intrusion by the refinery complex at street level. Since most of the homes on this street are ranch houses, they would not enable a view of the refinery. Potentially, the top of the refinery could be visible from the second floors of the few two-story homes along this street.

Source: William J. Cohen and Associates, Inc. 1982.

CONCLUSIONS

The observations recorded in Table 15 above show that Delaware City has a generally high-quality visual environment dominated by attractive landscapes and harmonious architectural forms. The Getty refinery complex presents an unattractive visual intrusion at only a small number of sites. The residential areas of Delaware City are free, for the most part, of this intrusion. Trees and other vegetation, along with the raised elevation of the spoils disposal areas, are responsible for preventing a view of the refinery complex from the residential area above Washington Street. However, it is probably true that the refinery becomes more visible during the winter season, when the leaves have fallen from the trees. The major visual detractions are caused by the predominance of the refinery at both major approaches into the town. The only other significant visual impact caused by the refinery occurs at the waterfront on Battery Park, where the bulk of Getty's marine terminal is visible to the north. At the same time, this location offers one of the most interesting and enjoyable views of the town, looking west down Clinton Street from the waterfront.

RECOMMENDATIONS

Since the Getty refinery is a large industrial facility which requires the intensive use of a number of rather tall structures, it is unreasonable to expect that the visual impact of the main part of the refinery can be meaningfully altered or camouflaged. This impact occurs only upon entering or leaving the community and is presumably going to have to be endured.

Two areas where the Consultant has determined that effective remedies can be applied so as to minimize negative visual impacts of the refinery, pertain to the visibility of the cyclone fencing and pipelines from the Clark's Corner to Delaware City Road, and the visibility of the marine terminal from Battery Park.

Accordingly, it is recommended that the Mayor and Council of Delaware City request of the Getty refinery management to consider the implementation of a landscape screening program. Such screening, involving the planting of suitable trees or bushes, can effectively be accomplished to conceal fencing, pipelines, and other low-lying

industrial facilities. The result would be to render these features relatively invisible from certain key visual vantage points. Priority attention should be given to the entrance of the marine terminal along Washington Street, which visually detracts from an otherwise aesthetically-pleasing vista at Battery Park.

It is further recommended that the Mayor and Council consider the development and adoption of a landscape screening regulation, applicable to new development anywhere in the town, which can be incorporated into the existing zoning code. This provision could be modelled on one adopted by the City of Newark in 1974.

CHAPTER NOTES

1 Roger S. Ulrich, "Visual Landscape Preference: A Model and Application," Man Environment Systems (Vol. 7, No. 5, 1977), p. 273.

2 Ervin H. Zube and Marshal LcLaughlin, "Assessing Perceived Values of the Coastal Zone," Coastal Zone '78 (Symposium of the American Society of Civil Engineers), p. 361.

3 Ibid.

4 Roy Mann Associates, Inc., Aesthetic Resources of the Coastal Zone, Washington, DC: U.S. Office of Coastal Zone Management, 1975), p. 28.

5 New Castle Gazette, May 12, 1961.

6 New Castle Gazette, May 19, 1961.

CHAPTER 8

WATERFRONT LAND USE IMPACT ANALYSIS

INTRODUCTION

This section involves an analysis of all lands within the corporate limits of Delaware City owned or used by Getty. The analysis has been structured using the following approach:

1. A land use survey was undertaken of all waterfront and adjacent areas.
2. A review of the City's zoning regulations relative to the identified land uses was performed.
3. A history was prepared of Getty's relationship to existing city zoning requirements.
4. Incompatabilities that can be said to exist between current land uses and zoning reegulations are discussed.
5. Recommendations are presented to address these incompatabilities.

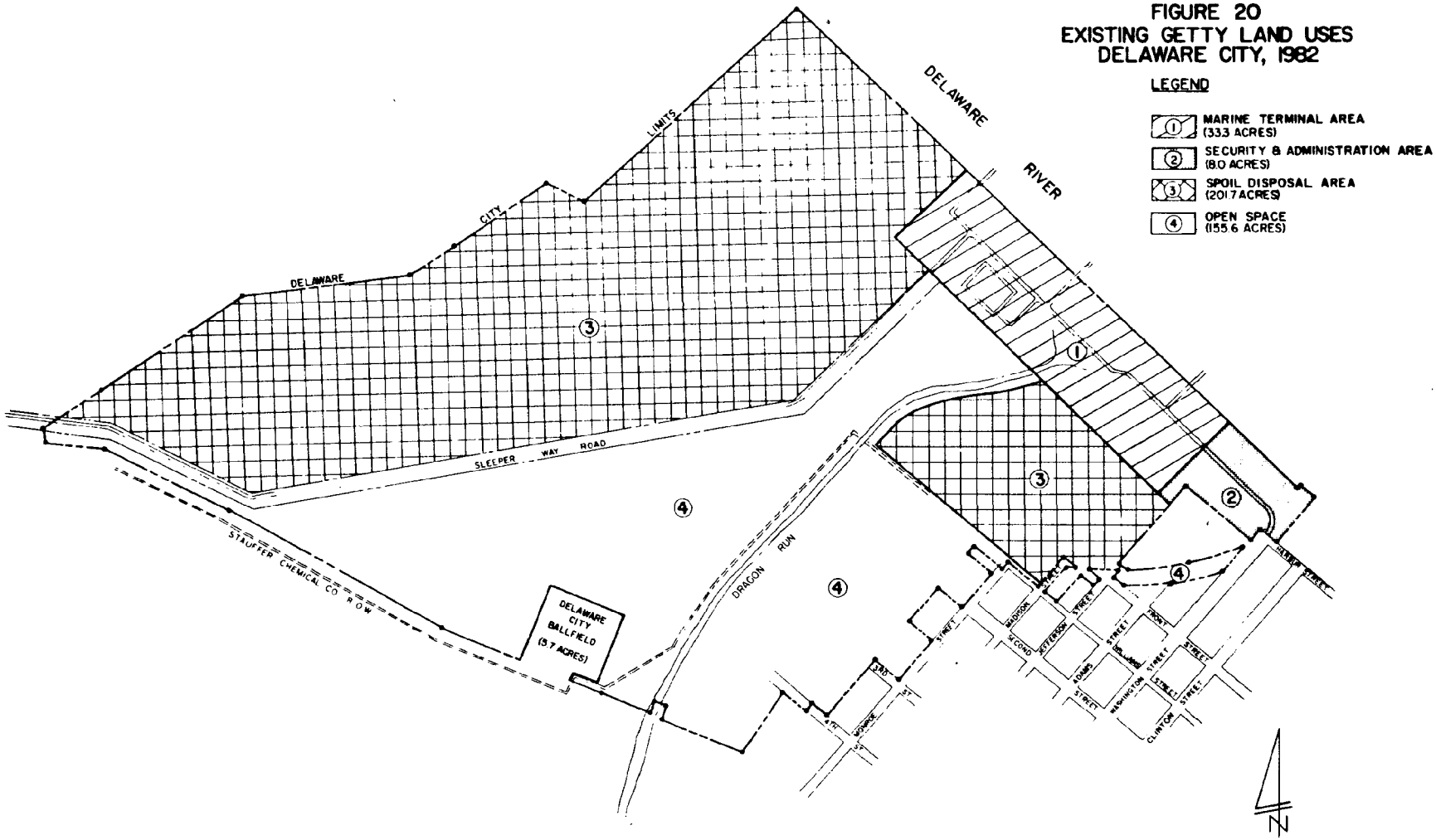
GETTY LAND USES IN DELAWARE CITY

A field survey was conducted in order to ascertain the type and extent of current land use activity on Getty property within the Delaware City corporate limits. Figure 20 shows the results of that survey. Land use categories have been established which best describe each definable land use activity and its components as follows:

* Marine terminal area—includes docking piers 1, 2, and 3; transmission lines; marine buildings (including administrative activities); and ballast water storage tanks.
* Security and administration facilities—includes security buildings and gate; parking areas; storage (outside and enclosed); and supply buildings.
* Spoil disposal areas—used for the deposit of dredged materials.
* Open Space—Consists of Dragon Run Creek; natural areas; and vacant land.

Table 16 provides a tabular summary of the total acreage of each of the land use categories in Delaware City.

FIGURE 20
EXISTING GETTY LAND USES
DELAWARE CITY, 1982



PREPARED BY:

WILLIAM J COHEN AND ASSOCIATES

NEWARK, DELAWARE

BASE MAP SOURCE: GETTY REFINING AND MARKETING COMPANY

TABLE 16

GETTY LAND USE ACREAGE IN DELAWARE CITY[1]
(1982)

Land Use Category	Total Acres	Percentage
Marine terminal area	33.3	8.4
Security and administration	8.0	2.0
Spoil disposal area	201.7	50.6
Open space	155.6	39.0
Total	398.6	100%

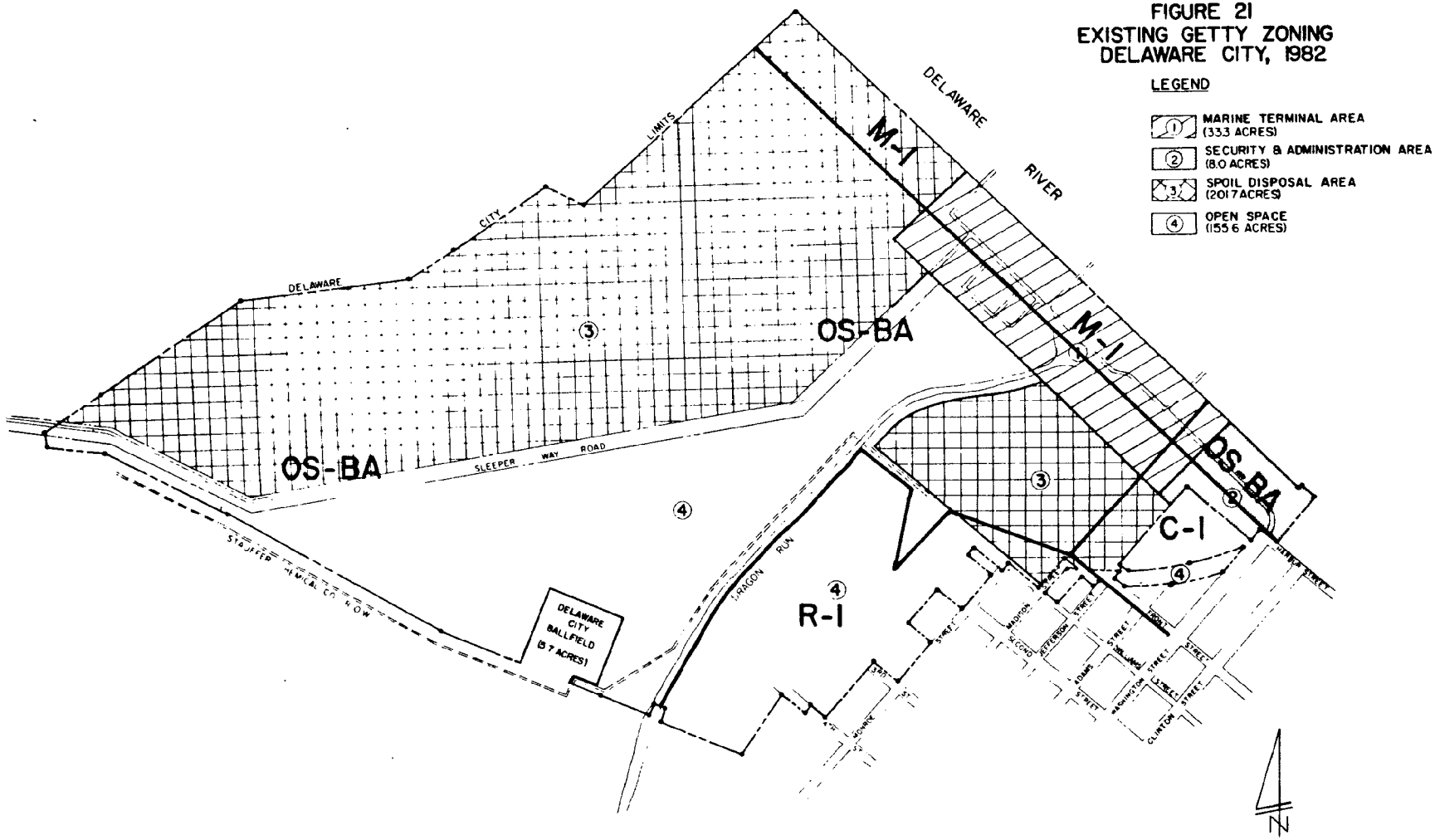
Notes: [1]This survey includes what may be referred to as the "Main Getty Complex," and does not include two isolated parcels under Getty ownership that are located on Monroe Street.

Source: William J. Cohen and Associates, Inc.

Existing Zoning of Getty Lands

Within the corporate limits of Delaware City the Getty lands are distributed among four zoning classifications. Figure 20 provides a map of present zoning within the City. Table 17 shows a comparative analysis between the current land use activity (as defined on Figure 20) and the existing zoning classification (Figure 21) including distinguishing land use characteristics or permitted uses.

FIGURE 21
EXISTING GETTY ZONING
DELAWARE CITY, 1982



PREPARED BY:

WILLIAM J. COHEN AND ASSOCIATES

NEWARK, DELAWARE

BASE MAP SOURCE: GETTY REFINING AND MARKETING COMPANY

TABLE 17

EXISTING GETTY LAND USE AND ZONING CLASSIFICATION

COMPARATIVE SUMMARY

Existing Land Use	Existing Zoning	Permitted Uses and Distinguishing Characteristics
Marine Terminal Area * docking piers * transmission lines * marine buildings	Light Industrial M-1	* dock terminal facilities * public utility rights-of-way and structures * accessory uses and structures
Security and Adminstrative Area * buildings and gate * parking areas * storage (outside and enclosed) * buildings	Open Space and Buffer Area OS-BA	* conservation areas * public utility rights-of-way and structures * pumping stations for waste water treatment and disposal * accessory uses and structures Special Conditions All facilities located in this district must be completely enclosed. No noxious fumes or odors are permitted. No loud noises are allowed. No manufacturing or storage facilities are allowed. All outside areas shall be planted with grass or other natural cover.
Spoil Disposal Area	Light industrial M-1	(refer to M-1 permitted uses listed above)
	Central Commercial C-1	* A variety of commercial and related uses such as retail stores, professional services, studios, restaurants, industrial activities, banks and financial institutions.

TABLE 17, Continued

Existing Land Use	Existing Zoning	Permitted Uses and Distinguishing Characteristics
Spoil Disposal Area, cont'd	Open Space-Buffer Area OS-BA Note: A small portion of the existing land use is zoned one-and two-family residential (R-1).	(refer to OS-BA permitted uses listed above)
Open Space * Dragon Run Creek * Natural Areas * Vacant Land	Central Commercial C-1	(refer to C-1 permitted uses listed above)
	One and Two Family Residential R-1	A residential category that allows: * one and two family dwellings * schools and colleges * libraries, museums, and art galleries * public facilities and uses * churches and other places of worship * professional offices under certain conditions * customary home occupation under certain conditions * other similar uses
	Open Space and Buffer Area OS-BA	(refer to OS-BA permitted uses listed above)

Source: William J. Cohen and Associates, Inc.

HISTORY OF DELAWARE CITY ZONING ACTIONS AFFECTING GETTY-OWNED LANDS

The documented history of zoning changes that Delaware City has entertained over the years either from or on behalf of Getty can provide the following perspectives:

First, it focuses on how effective the municipal zoning code is in regulating Getty as a coastal energy activity.

Second, it can serve as a signal to any potential land use conflicts that have, might, or could exist between the community's environmental and recreational resources on the one hand, and current land use operations of Getty on the other.

Zoning Code Amendment in OS-BA District (1976)

When the Delaware City Zoning Code was passed on April 23, 1973, the establishment of the Open Space and Buffer Area (OS-BA) District permitted, as a matter of right, only three classes of uses:

1. conservation areas;
2. public utility rights-of-way and structures; and
3. accessory uses and structures incidental and customary to and associated with the operation of the permitted uses.

No conditional uses were provided for. The only change to the above permitted uses occurred on September 27, 1976, when the Mayor and Council, at their initiative, passed a zoning code amendment to allow "pumping stations for waste water, waste water treatment facilities and waste water disposal structures." The reasoning behind this amendment was stated as follows:

> "The proposed amendment related to the OS-BA District would allow Stauffer Chemical Company and others located in the OS-BA area to have access to the Delaware River for pumping of waste water, with certain conditions imposed. Pumping of other substances would be allowed only through a Special Exception (Article XIII, Section 2) by approval of the Board of Adjustment and with such conditions as it deems necessary. The adjoining property to the west consists of a prior non-conforming use as light industrial (The Getty Oil Company docks and offices), and the amendment contains special conditions to create harmony with the adjoining areas. Although at the time Stauffer Chemical has not executed a written agreement with the City of Delaware City, it has expressed an intention to transfer the remainder of its waterfront property to the City in order that the State of Delaware may build a park for the citizens of Delaware City. If such transfer takes place, the City intends to lease the park land to the State of Delaware for park and recreational use only."

In addition, a "special condition" was added to the OS-BA district as follows:

> "All facilities located in this District must be completely enclosed. No noxious fumes or odors are permitted. No loud noises are allowed. No manufacturing or storage facilities are allowed. All outside areas shall be planted with grass or other natural cover."

Proposed Waterfront Rezoning (1976)

On June 7, 1976, the Mayor and Council, at their initiative, proposed a rezoning of lands of Stauffer Chemical Company, between the City-owned lands (now known as Battery Park) and the Getty holdings. The parcel, although only containing 0.3 acre, included 225 feet of river frontage on Harbor Street. The parcel's zoning was OS-BA, and it was proposed by the Mayor and Council to be changed to M-1.

The purposes stated for the rezoning were justified as follows:

> "The proposed amendment would grant to Stauffer Chemical Company the right to M-1 use of a portion of the Delaware City waterfront property which it has owned since 1959 and purchased for the very purpose of future access to the Delaware River. Stauffer Chemical Company has been a good neighbor to Delaware City and has provided jobs for the citizens of Delaware City. The remaining portion of the Stauffer waterfront property will continue to be zoned OS-BA (Open Space and Buffer Area). As the adjoining property to the west consists of a prior nonconforming use as light industrial (the Getty Oil Company docks and offices) we believe there is a no detriment to the public health, safety, and general welfare of the community. On the contrary, a policy of encouragement of good relations with our industrial neighbors should be followed. Indeed, such a policy does in fact promote directly and indirectly the public welfare."

> "Although at this time Stauffer Chemical has not executed any written agreement with the City of Delaware City relating to the waterfront property, it has expressed an intention to transfer the remainder of its waterfront property to the City in order that the State of Delaware may build a park for the citizens of Delaware City. If such transfer takes place, the City of Delaware City intends to lease the park land to the State of Delaware for park and recreational use only for a period of ninety-nine years."

Special Exception—Temporary Office (1976)

Getty made application for a special exception before the Board of Adjustment to allow the use of a mobile home unit as a temporary office for a period of six months. The exception would have permitted a temporary office in the M-1 zone, needed for certain construction activities. The hearing came before the Board of Adjustment on July 22, 1976, and according to City records, the request was approved.

Waterfront Rezoning (1976)

On September 27, 1976, the Mayor and Council, at their initiative, passed an ordinance that involved a re-zoning to change the zoning map, affecting a portion of land on the City waterfront zoned OS-BA. The approved change re-zoned 0.9 of an acre owned by Stauffer Chemical Company to Open Space and Recreation (OS-R). The improvement of the State-owned land on part of the Fort Delaware State Park and including the City's Battery Park clearly was a factor in this action. The City stated:

> "The change of the Park area along the Branch Canal and Delaware River and certain lands of Stauffer Chemical Company from OS-BA to OS-R (Open Space - Recreation) is necessary to reflect the expanded use of the Park area for recreation."

Zoning Code Amendment to Provide for Coastal Flood Plain (CFP) District

The Mayor and Council passed ordinance 4010A on February 14, 1977, which amended the City zoning code by creating a new "overlay" district known as Coastal Flood Plain (CFP) District. The flood plain district was to be based on the U.S. Department of Housing and Urban Development's Flood Insurance Study (issued August 1976) and determined as the area subject to the 100 year flood. The ordinance specifically stated that within the CFP the following shall not be allowed without a Delaware City Coastal Flood Plain Building Permit:

a. Any new construction, reconstruction, enlargement, alteration or relocation, of any structure, residential, non-residential, or otherwise;

b. Any proposed development or subdivision;

c. Substantial improvements to an existing structure; and

d. Placement of a mobile home, mobile home park or mobile home subdivision.

Board of Adjustment Variance—Coastal Flood Plain (1977)

Getty applied for and received a variance from the Board of Adjustment on July 6, 1977, to construct a waste water treatment facility to treat ships' ballast water within the recently enacted Coastal Flood District. Being cognizent of the potential flood hazard, Getty submitted plans and details of the project. The Board based its decision on four "reasons", one of which stated:

"2. Exceptional hardship would accrue to Getty if the Variance were not granted in that compliance with Federal pollution regulations would not be possible;"

Board of Adjustment Variance (1979)

On May 31, 1979, Getty submitted a letter to the Board of Adjustment requesting a variance to install a 14 inch pipeline to carry toluene from the refinery tankage to pier #3 for loading aboard barges and ships. The area in question was zoned OS-BA. On June 19 the Board's unanimous decision was to grant the variance, citing the following justification:

"(1) The Getty Refining and Marketing Company has made a showing of good and sufficient cause by submissions in its letter of May 31, 1979 and representations submitted through its exhibits at the hearing and meeting of the Board of Adjustment on June 19, 1979;

(2) Unnecessary hardship and exceptional practical difficulties would accrue to Getty if this variance were not granted;

(3) The granting of this variance will not result in a substantial detriment to the public good and will not substantially impair the intent and purpose of the zoning code."

LAND USE AND ZONING CONFLICTS

It is clear from the previous presentation that the following incompatibilities can be said to exist between current Getty land uses as well as related land uses under

control of the Stauffer Chemical Company, and the City's zoning regulations.

1. The present land use patterns of the Getty property are obviously a function of the operations of the refinery, and therefore are not expected to be changed or altered through the regulatory provisions of the present zoning of these lands. As a result, the zoning designaton OS-BA over the majority of the Getty lands is not only inconsistent with the established land use pattern, but does not really fulfill its intended regulatory purpose—to provide an open space and buffer area. Either by design or accident, the true open space area is found on the southerly side of "Sleeper Way Road", which is partially zoned R-1.

The OS-BA zoning designation for the Delaware River frontage that currently is used by Getty as its security and administration facilities, as well as a small portion of the marine terminal, is clearly inconsistent since this area is being utilized in a traditional "industrial or manufacturing" manner.

In essence, the current and established land uses of Getty over a majority of its property in Delaware City are incompatible with their respective zoning designations. This situation results in a pervasive pattern of nonconforming uses.

2. Because of the construction of the zoning code, especially as this applies to the OS-BA District, Getty has found it necessary to seek a number of variances in order to construct or modify facilities that are necessary to the operations of the refinery. While the City has been sympathetic and understanding in granting variances, the broader land use questions have never been addressed. In other words, the City's zoning process is weakened by the fact that such a major land use as the Getty refinery, is defined as a largely nonconforming use. The only exception to this is the marine terminal area, which is zoned M-1 and permits, as a matter of right, the types of uses that do in fact currently exist (primarily the dock terminal facilities).

3. The current M-1 zoning district is characterized in the Delaware City zoning Code as "light industrial." With the exception of Dock Terminal facilities, this zoning classification provides for land uses which the City may wish to encourage, through the location and development of light industry. The reality of the situation is that the Getty land uses should not be classified as "light industrial," but rather be dealt with through the Zoning Code as a more intensive manufacturing use. It would be more advantageous to reorganize the industrial (or manufacturing) zoning provisions to provide the City with a light industrial district and a separate district specifically related to Getty operations.

RECOMMENDATIONS

Following from the above analysis, specific recommendations can be forwarded to achieve the following:

First, clarify the inconsistencies between current Getty land uses and how these uses could be reasonably regulated through the mechanism of zoning.

Second, establish a set of zoning regulations that can be incorporated into the existing Delaware City Zoning Code, that will be both fair to Getty and reasonable for the City to administer.

The above can be accomplished if the City provides for two revisions to the Zoning Code, and one revision to the zoning map, including:

* Redesign the M-1 (light industrial) zoning classification to allow the City to have a district that could attract new forms of acceptable light industrial (nonpetrochemical) land uses;

* Establish a new zoning classification, M-R (Manufacturing-Refinery), to be specifically intended to regulate Getty operations, especially in the areas previously referred to on Figure 20 as the marine terminal area and security and administration facilities; and

* Rezone the Getty lands within the City to conform to the new zoning classification M-R where appropriate, and adjust the zoning district lines of the OS-BA and C-1 zoning districts to reflect current land use realities.

B. ECONOMIC AND SOCIAL IMPACTS

CHAPTER 9

HISTORY OF THE GETTY-DELAWARE CITY RELATIONSHIP

INTRODUCTION

The rich and at times exciting history of Delaware City has been faithfully recorded and disseminated by a number of devotees over the years since the latter part of last century.[1] The purpose here is not to duplicate these efforts, but rather to highlight certain elements of this history, as revealed in these efforts, which are germaine to understanding the impact that the Getty Refinery has had upon life in the community. Such a review, by necessity of its purpose, must present the historical record based upon a division into two major parts: Delaware City before Getty; and Delaware City since Getty.

Because an historical perspective is really an interpretation of past actions, events, and conditions, it incorporates a large variety of different human undertakings. Accordingly, this summary will at various times dwell on the economic, the social, and the political life of the town and its inhabitants. These aspects will also be addressed individually in more detail, in subsequent chapters of this report.

DELAWARE CITY BEFORE GETTY

First Years of the Town

For much of the 130 years that the town existed prior to the construction of the Tidewater Associated Oil Company's (Getty's) Delaware City refinery, the town's fortunes seem to have been buffetted up and down by circumstances over which the townspeople, in most cases, had little or no control. This is true from the very beginning, during the years 1824-29, when the construction of the Chesapeake and Delaware Canal provided the first set of conditions for a town to flourish at Newbold's Landing. It was during this period, in 1826, that brothers Daniel and William Newbold, heirs to the land on which most of the town now stands, tried their hands at urban design by laying out some of the first streets. The town-to-be was christened Delaware City, a name which reflected the owners' expectations of the town's future prominence—it was intended that the town would surpass Philadelphia in size and importance.

This expectation turned out to be nothing more than a fantasy. Nevertheless, things were off to a healthy start during the first year—ten houses and the first post office were constructed. Within the next year, the Newbolds sold their interests to Manuel Eyre. Through his initiatives, several more houses were built, along with the Delaware City Hotel, which still stands and is currently known as the Olde Canal Inn.

The "Golden Age of Delaware City"

Although Delaware City never became a Philadelphia, or anything near it, life in the town took on an active and diverse pace. In 1851, the town was officially incorporated as a municipal jurisdiction. The second half of the Nineteenth Century could perhaps be characterized as the "Golden Age of Delaware City," owing to the great variety and intensity of activities, including:

* Shipping—The completion of the canal in 1829 had not brought quite the level of glory and importance to Delaware City that its founders had envisioned. Among the reasons for this shortfall was the fact that the railroads came to the region shortly thereafter, thus offering some rather stiff competition to the canal. Nevertheless, the canal caused Delaware City to become both an operating base and a way station for a number of

significant shipping-related activities. The operation of the canal brought a number of coal and lumber barges through the town each week, and there were also the excursion boats of the Ericson Line which travelled through the town on their way between Baltimore and Philadelphia. The "Major Reybold" and "Thomas Clyde" steamers carried peaches and other goods between Delaware City, Philadelphia and New York, and locally-based fishing boats brought in the sturgeon, herring, oysters, and other seafood varieties that made Delaware City an important fishing port. The realignment of the canal two miles south of Delaware City in 1927 all but ended the town's involvement in shipping.

* Peach Farming—a peach boom during the years 1840-1880, which made Delaware City famous for popularizing peaches nationwide, was started by Major Philip Reybold and his sons, who had over 110,000 trees by 1845. A discovery by grower Isaac Reeves, which enabled the growing of budded peach trees, greatly extended the yield of his trees, as well as Delaware City's output of peaches. Peach growing in this area was wiped out by a blight in the 1880's.

* Fish Processing—fish caught by Delaware City fishermen were processed and shipped from the town. The most noteworthy fishing activities centered on the catching and processing of sturgeon. At least three local companies were engaged in these efforts, finding a profitable use for the entire fish. Of special value were the roe sturgeon, which yielded over 100,000 pounds of caviar valued at almost $20,000 in 1889.[2] This caviar, after being shipped to Germany and Russia where it was packaged, was distributed around the world. Much of it came back to America, marketed as fine "imported" caviar. The fishing industry was virtually nonexistent by the 1930's, a circumstance which has been blamed on the pollution levels of the Delaware River by the early part of the Twentieth Century.

* Other Commercial and Industrial Activities—Major Philip Reybold, until his death in 1854, was the town's most illustrious citizen and entrepreneur. In addition to becoming known as the "Peach King," he, at various times, was involved in the raising of castor beans, sheep, and grains, which he produced into castor oil, meat, and bread, respectively. His fortunes also extended into brick production, which provided building material for buildings as far away as New York and Philadelphia. Other entrepreneurs in the town established a blacksmith shop, a carriage shop, a grist mill, a sheet metal factory, and a mincemeat factory, all of which operated during this period of time. Evidently, the "Town Fathers" were not entirely satisfied with the level of commercial activity: in 1887 an act was passed by the commissioners providing ten-year tax exemptions for small-scale industrial establishments.[3]

Taken together, these activities created prosperity for the young town. To some extent, this prosperity continued into the 1920's, but a gradual decline appears evident from the beginning of the current century.

Depression Years

By the early 1930's, the town appears to have reached its lowest point. The peach growing trade was long-gone. Also gone was the official use of the segment of the canal which cut through the town, having been relocated two miles to the south. The fish which had helped the town to thrive were rapidly disappearing. Delaware City was cut

off in other ways, too—the railroad which had connected it with Newark, Wilmington, Philadelphia, Baltimore, and lower Delaware since 1871 had been terminated in 1928. Even a trolley line, which had connected the town with New Castle and Wilmington since 1900, was pulled up in 1931. The newly-constructed duPont Highway, which instantly became a vital link between Wilmington and the Delmarva Peninsula, passed several miles to the west of the town, leaving it largely ignored by highway travelers. This place, which had once been the hub of a vast and multi-dimensional transportation network, was now all but isolated, a victim of modern change. A 1935 newspaper article depicted Delaware City as ". . . a pleasant country hamlet and fishing center . . . untouched even by the duPont Highway which has done much to develop the importance of other villages."[4] On top of everything else, the Great Depression had set in, spreading hardship and despair throughout the land in epidemic proportions.

Perhaps owing to a strong survival instinct, or the industriousness and resilience of the people, or their ability to pull together tightly in the face of adversity,the townspeople weathered the worst of the hard times successfully, according to the historical record. The record indicates that for many town residents, a means of livelihood had to be sought somewhere else, such as the cannery located at Port Penn, the DuPont Company facilities in northern New Castle County, or the Delaware Rayon Company, north on the River Road.

The economic fog which had settled in over the town during these years started to lift by 1936, as a result of a massive construction project undertaken by the Works Projects Administration to widen and deepen the canal, and improve the canal bridges and entrance jetties. Despite the distance of the canal from Delaware City as a result of the 1927 realignment, it is believed that this $14 million project brought needed economic benefits to the town.

The 1940's

The next decade brought some major changes to life in Delaware City. For one thing, the community became somewhat of a college town, as the result of the establishment of King's College in 1941 on the grounds of the former Major Philip Reybold estate, Lexington, located two miles northwest of the town. The College was able to make good use of Major Reybold's former mansion, which had been the home of the Henry P. Scott family in the intervening years. The school renovated the building for administrative offices, while preserving the architectural integrity of the exterior. The students who came to King's College pursued an education in liberal arts, sciences, and several professions, in a Christian-oriented atmosphere, since the College was founded by the Young People's Association for the Propagation of the Gospel. It is not known to what extent students from the college intermingled with people from the town. In any event, the college continued to operate at that location until late 1955, when the Tidewater Associated Oil Company (Getty), which had purchased the property from the college, commenced construction of its refinery on the site. The mansion and its associated buildings were demolished, and King's College relocated on the Hudson River in New York.

The second major change during these years resulted from this country's entrance into World War II. While many of the younger men of the town went off to fulfill their patriotic duty, a number of the remaining townspeople were busy assisting the war effort at home, and otherwise keeping family and community life intact. Delaware City's major contribution to the war effort at home centered on what took place at Fort DuPont, located south of town between the old and new canal alignments. Having been initially constructed in 1899 to provide a strengthened defense of the Delaware River Valley, the fort saw little action until 1941. During that year, the Federal Government undertook a

$2 million building project there, thus greatly expanding the facilities. Shortly thereafter, two artillery installations, one from Delaware and one from New Jersey, were located there for the remainder of the war. As many as 3,000 military and civilian personnel were based at the fort at the height of this period. In addition, toward the end of the war, the fort served as a prisoner camp for as many as 1,000 German prisoners of war. As a result of the constructon and subsequent operations activities at the fort during these years, it has been stated that the townspeople benefitted greatly, owing to the opportunities for direct employment and related economic stimulation.

For this reason, it is probably true that the end of World War II came as a mixed blessing to the town's residents. The Army no longer had use for the facility, and in December, 1945, it was closed and abandoned. This action allegedly created a great concern among town residents, because of the lost jobs and commercial trade which resulted.[5] After several years of negotiation, the facility was turned over to the State of Delaware. Some improvements were made to buildings, and in October 1948 the Governor Bacon Health Center was opened there and is currently still operating. It is not known to what extent the Center has contributed to employment and retail activity in the town, although it is probably significant.

The 1950's

By the early 1950's, it appears that Delaware City had fallen into another slump in terms of economic and cultural activity. The presence of a major source of industrial or commercial stimulation had thus far failed to materialize. The flurry of activity at Fort DuPont was, by then, little more than a faded memory, and the Governor Bacon facility had only partially filled this vacuum. Furthermore, some of the town's most prominent historical and architectural features, such as the old canal entrance, Fort Delaware on Pea Patch Island, and the Delaware City Hotel, reflected the effects of many years of neglect.

Fortunately, members of the community became aroused to the level of taking action on some of these matters. The recently-established Fort Delaware Society (1948) began to undertake efforts to restore the fort on Pea Patch Island as an historic monument, with the hope of generating much-valued tourism. The Delaware City Lions Club organized in May 1951, avowing to be ". . . dedicated to the task of making Delaware City what they know it can be."[6] One of the club's first projects was to undertake a campaign to promote the town for new business and industry. It was even anticipated that efforts to clean up the badly-polluted Delaware River, being undertaken by the Interstate Commission on the Delaware River Basin (precursor of the Delaware River Basin Commission), would enable the resurrection of the defunct fishing industry.

Some of these efforts began to bear fruit, while others did not. One effort which did not bear fruit was the resurrection of the town's fishing industry. Even today, with the tremendous improvements which have been made relative to water quality in the Delaware River, fish populations have not yet regenerated enough to permit more than sport fishing in this segment of the river. A more successful effort has been the restoration of many of the town's historical sites, including Fort Delaware, which together bring more than twelve thousand tourists through Delaware City each year.

By many accounts the most dramatic change to the community, indirectly a result of these promotional efforts, has been the location of the Tidewater (Getty) refinery along the northern edge of the town boundaries, and extending several miles to the west.

The coming of this giant industrial complex involves a history that dates from early 1954. It was on a day in January of that year that a Mr. R. S. Stanfield, Chief

Engineer at Tidewater's Bayonne, NJ refinery, first visited Delaware City and its environs. He was accompanied by a Mr. Edward Elliott of C. F. Braun and Company, a Los Angeles-based engineering firm which had been retained by Tidewater to manage the development of a new refinery for the petroleum producer. They were shown a large tract of land by a representative of the Delaware State Development Commission. The land which they saw extended from an area of tidal wetland at the edge of the Delaware River, several miles westward above Wrangle Hill Road. It was one of approximately 30 sites along a vast portion of the East Coast that Messrs. Stanfield and Elliott had already investigated.

Apparently, they were very impressed with what they were shown, for almost immediately, Tidewater took options on some 1,200 acres of this land. Among the reasons cited by company officials for selecting the Delaware City site were the following:[7]

- The existence of an old and abandoned shipping channel in the Delaware River which was accessible from the site;
- The available acreage at the site, including direct access to the river;
- The excellent load-bearing ability of the soils at the site;
- The ample supply of fresh groundwater at three different levels of aquifer formations; and
- The ready access of good rail and highway transportation.

It is possible that an additional factor may have influenced Tidewater's decision—the receptive and cooperative spirit expressed by the Mayor and Council of Delaware City. The governing body further demonstrated this spirit shortly after the company began formalizing its plans. On May 3, 1954, the Mayor and Council unanimously passed a resolution to remit all property taxes in excess of $10,000 which would be levied upon the portion of the refinery within the corporate limits, for each of ten years. This action, which was legally based on the 1887 tax exemption ordinance and subsequently-enacted charter provisions, caused a number of legal, financial, and political problems in ensuing years. However, it clearly demonstrates the receptive attitude of city officials during the time that Tidewater was making its initial decisions.

Throughout 1954 and the first half of 1955, Tidewater was busy executing its land options and acquiring much additional acreage. The company was apparently aided in this program by a real estate agent with a "bullish attitude," which caused a strain in the early relations between the company and the town.[8] Much of this land was then being farmed, with the exception of the portion being used as the campus of King's College. Parcel by parcel, the company assembled and consolidated its acquisitions. By April of 1955, King's College was already finalizing its plans to vacate its campus by the summer.[9] By June, Mrs. Alfred A. ("Aunt Genie") Grimes and her son, Albert A., knew that they would have to shortly vacate the 187-acre farm which they had operated for many years. They had leased it from Mrs. Grimes' sister-in-law, Mrs. Harry P. Gray, who sold it to Tidewater for slightly more than $100,000. It is understood that Mrs. Grimes and her son were at least able to enjoy a share of the proceeds of the sale.[10]

By July, preparation of the refinery site was well-underway. The Reybold mansion along with a number of other buildings, was demolished during this time. According to company officials, there was no practical use for the 60-room mansion which had served well as administrative office space for King's College.[11]

Sometime around the middle of the month, a peculiar snag was encountered during site excavation at a knoll east of the River Road where a cherry tree stood, overlooking the Delaware. Two graves were discovered, dating back to the late 1700's. If the survivors of Peter Hanson and his daughter, Elizabeth, had known that this portion of the Hanson property would become part of a giant oil refinery almost 200 years later, they might have found a more eternally peaceful resting place for the two. The records indicate that they deserved this much; evidently, the lives of this man and his daughter were wrought with difficulty—both died at a very early age. Peter, who died in 1768, was 33; and Elizabeth, who died in 1786, was 22. The Hansons, whose ancestors were related by blood to King Gustavus Adolphus of Sweden, had at one time owned virtually all of the northeastern portion of Red Lion Hundred. The Reybold and Clark families had subsequently purchased the Hanson land holdings.

It appears that Tidewater officials handled the situation sensitively. They halted all excavation work in the immediate area, leaving the graves intact and protected by fencing. They consulted the State Police and the Attorney General's Office in order to trace and contact any surviving descendants of the two. As a result of these efforts, the remains were ultimately claimed and removed to another burial site.[12]

One year later, in July of 1956, refinery construction activities reached their peak. As many as 9,000 workers were employed at the site during that time in a variety of construction jobs, two-thirds of them having come from other states. As many of these out-of-towners as could be accommodated, crowded into every available boarding space in Delaware City. The two hotels in town were filled to capacity, homeowners rented their spare bedrooms to strangers, and there were even trailers hastily placed off Clinton Street. Meanwhile, some of the company's executives were busy looking for homes in town and the surrounding areas.[13]

Within months, construction workers were beginning to be laid off on a large scale. By February, 1957, the Delaware unemployment rolls had swelled to an unprecedented level, largely due to these construction layoffs from the refinery, which was then nearly completed. Among those people receiving unemployment compensaton for that month, were over 6,000 out-of-state construction workers who had been laid off from the refinery construction.[14]

It was during this time that town residents, even those who had strongly favored the coming of the refinery, were probably having second thoughts about how the town would benefit from the facility's presence. The perpetual dust which had plagued the town throughout the construction project had at least been offset by the tremendous retail trade benefits which had been enjoyed. With those benefits largely diminished, and the time fast approaching when the refinery would commence to operate, people's attention turned to their fears of the smoke and odors which they believed would be their legacy.[15] It can be surmised that at least some of the townspeople had travelled through Marcus Hook, PA., thus providing a realistic basis for their fears.

The official opening ceremonies for the refinery comprised a two-day gala event. Many of the most prominent elected officials in the state made an appearance, including the governor, the U.S. Congressional delegation, and a number of state legislators. All of the top Tidewater officials were there as well. Amid company proclamations about its "good neighbor" posture, town residents who accepted the open house invitation were assured that odors from the refinery would be minimal, owing to the facility's state-of-the-art sulfur recovery plant. " 'The meat packers claim they package and sell everything but the squeal of the pig,' a Tidewater spokesman jests. 'Well, we are even packaging and selling the stink of oil'."[16]

DELAWARE CITY SINCE GETTY

There is no question that the coming of the Tidewater Associated Oil Company (Getty) to Delaware City has brought significant changes to life in the town, not to mention the entire State. Whether these changes, on balance, have been to the betterment or detriment of the local community depends, to an extent, upon one's perspectives on the matter. However, many of these changes represent an objective reality which stands on its own, irrespective of the different views and interpretations of those people who have analyzed the situation.

One reality is that a 140,000 barrel-a-day refinery and its related facilities manifests itself on the physical environment, where there once existed open farmland and a small college campus housed in the quarters of an historic Delaware estate.

Another reality is that starting with fiscal year 1958, Delaware City began to realize a substantial increase in property tax revenues, yielded by the portion of the refinery which lay within the city's boundaries. The difference in revenues, taking into account what was paid on this property previously, amounted to more than $9,000 per year until fiscal year 1966. Starting with that year, the ten-year tax remission which had been granted to the company expired, and the tax revenues from this property increased to over $20,500 in that fiscal year. These additional tax revenues have enabled the city to afford a number of improvements and purchases over the years, augmented by periodic contributions and loans of equipment by the company.

A third reality, which has manifested itself as a benefit to the community, relates to the economic opportunities made possible by the refinery. Initially, these opportunities pertained to the economic activity associated with the construction of the refinery during the years 1955-57, as discussed earlier. The subsequent opening of the refinery did not immediately produce employment opportunities for town residents to the extent that had been expected. This may have been partly due to the transfer of many existing employees to Delaware City from elsewhere, and partly to the relatively specialized qualifications which the company needed from many of its prospective employees. It can be surmised that few town residents were trained or educated in areas that would have provided them with such qualifications. It can, therefore, be further surmised that only a small portion of the 1,000 to 1,200 job opportunities initially available at the refinery would have been available to the people from the town. This is borne out by the fact that, over the years, only about 20-40 refinery jobs have been filled by town residents, according to estimates from several sources.[17] It is highly improbable that the company would have refrained from hiring town residents who met the qualifications.

Even though this number of job opportunities may not have been satisfactory in some ways, it nonetheless represents 20-40 jobs that otherwise would not have existed. In addition, town merchants have benefitted significantly over the years from the trade with the company, its employees, and associated personnel. These matters are discussed in detail in a subsequent chapter of this report.

A fourth reality pertains to what might be described as the town's identity. The coming of the refinery has clearly affected how the community perceives itself, as well as how it is perceived by others from outside the town. Invariably, these perceptions link the refinery with life in the town. It is interesting to note that outsiders have, from time to time, made the observation that the quaint town sits ". . . undisturbed by an automated oil refinery a mile to the north. . .".[18] Even if the validity of this type of observation was undisputable, and it is not, it still defines the town's existence by making reference to the presence of its giant neighbor to the north. Moreover, many of the

town's most prominent citizens assert that life in the town has been greatly affected by the refinery. They only disagree as to whether the effects have been more beneficial or more adverse.

Thus, it quickly becomes apparent that the town's recent and current identity is tied to its relationship with the refinery and the people who operate it. To better understand the nature of this relationship, it is instructive to note the interactions which have transpired between the two over the years. These interactions reveal how each party has perceived itself, and how each has perceived the other.

One of the earliest such events occurred during a meeting of the Mayor and Council of Delaware City on May 3, 1954. It entailed a resolution to limit property taxes on the portion of the refinery to be located within the town, to $10,000 per annum for a period of ten years. This resolution was unanimously passed, " . . . as an inducement to said Tidewater Associated Oil Company so to erect such refinery and appurtenant facilities . . . ".[19] The Mayor and Council thereby gave " . . . written assurance to said Tidewater Associated Oil Company of the foregoing remission of such taxes upon the conditions herein above set forth."[20] Tidewater officials presumably received this communication with pleasure.

The young relationship was tarnished shortly thereafter by the "bullish attitude" allegedly exhibited by the company's real estate agent in his efforts to negotiate with local landowners toward the company's land acquisitions for its planned refinery. Delaware City's mayor at the time, William J. Smith, had registered his ". . . thorough disagreement with (the agent's) business ethics."[21] As a result, the company corrected the problem to the satisfaction of the landowners involved and city officials.

The relationship between the town and the company appears to have continued on a positive note throughout most of the period during which the refinery was being constructed. Aside from the pervasive dust which came to town from the construction site, the town benefitted greatly from the construction activities.

The next major communication came from a company official during the opening ceremonies for the refinery. George Getty II, then a vice president with the company, was quoted as saying: "Now, and in years to come, this Delaware refinery and all the people who work here will be good citizens, good neighbors and partners in progress with all people of Delaware."[22] It is important to note that the company's concern, from its perspective, was for a good relationship with "all people of Delaware," and not exclusively with the people of Delaware City.

Within months of the refinery's opening, relations again became tense. The source of the tension was a realization, on the part of the Mayor and Council, that the resolution of three years previous, which had granted Tidewater the ten-year property tax remission, was of questionable legal validity. Moreover, the city was endeavoring to undertake a large-scale civic improvement program, for which it needed additional funds. Mayor Smith, in a letter to R. S. Stanfield, Refinery Representative, implored the company to give ". . . serious consideration to taking no tax exemption so we can make this objective (the improvement program) come true more quickly. We believe this accomplishment would be an excellent example to be cited for a large company - community cooperative relationship."[23] The company chose to not develop the relationship to the extent that Mayor Smith had suggested. Based upon legal opinions obtained from both sides, the Mayor and Council decided against ". . . violating the spirit of the original agreements. . .".[24] The matter was thereafter shelved. Mayor Smith subsequently expressed to Walter J. Harrison, Refinery Representative, the hope that ". . . the friendly cooperation between your company and ourselves will continue since we

can be mutually beneficial to one another."[25] Despite this hope, the tax exemption continued to be a controversial issue for a number of years, as discussed in more detail in Chapter 13, Fiscal Impacts.

The relationship was marked during the next several years by periodic complaints from the town concerning air pollution, oil spills, odors, and noise emanating from various refinery operations. The records indicate the company's cooperativeness, for the most part, in trying to resolve these problems. On March 12, 1960, the Mayor and Council unanimously adopted a resolution citing Tidewater's contribution to the community, and stating that the city was not disappointed in its decision to grant a tax abatement in order to encourage the company to locate in Delaware City. The resolution also noted the company's cooperativeness in addressing the odor problems.[26]

The following year, 1961, brought controversy to the relationship once again, sparked by a Shell Oil Company proposal to develop a refinery on land it had acquired along the Delaware River, south of Augustine Beach. A number of Delaware City residents testified, at public hearings, against the Shell refinery proposal, citing their numerous complaints against the Tidewater refinery. Mayor Smith, however, took a different position. In a letter to George Caine, Manager of the Tidewater refinery, he asserted that the people making attacks against Tidewater didn't ". . . investigate the true facts."[27] He proceeded to present what he considered to be ". . . an informed statement of what has really happened since the Delaware refinery located within and adjacent to Delaware City."[28] He stated that Tidewater and Delaware City ". . . have enjoyed mutual respect and consideration."[29] He also pointed out several beneficial impacts of the refinery, including equipment lent to the city by the refinery; payments to the city in exchange for mowing and sweeping services provided to the refinery; donations to the town library; and donation of a building to be used as a community center (the building was subsequently sold by the city).

The next major breakdown in the relationship took place in the summer of 1964, and continued into early 1965. It involved a revival of the long-standing tax exemption controversy. On July 1, 1964, Delaware City sent Tidewater a tax bill for $20,548.45, on the assumption that the ten-year tax abatement had by then expired, since it was ten years after the Council resolution was adopted. In a letter to the city on September 30, 1964, Mr. Harrison of Tidewater pointed out that the exemption began when the tax was first levied, which was July, 1955. Therefore, he maintained, it would not expire for at least another year. This misunderstanding caused quite a hardship on the city, which had made some rather heavy financial commitments in the belief that the additional revenue would be forthcoming. The problem was the result of certain ambiguities in the agreement which had not been adequately clarified from the beginning. The ill feelings that it created did their share to erode the relationship.

Later in 1965, another problem arose. A complaint was transmitted to the company, on behalf of town merchants, concerning out-of-state merchants parking trucks at the company's marine terminal, and selling dry goods to the men on the ships. These merchants did not have a Delaware City merchant's license and were allegedly taking business away from local merchants. The company responded that the one merchant in question was a Greek immigrant from Philadelphia, who supplied special items and services to Greek sailors. His service was considered essential by the ship owners.

Starting with fiscal year 1966 (July 1, 1965), Tidewater began paying property taxes to the city based on the full amount due. There is no doubt that this helped to relax tensions between the company and the city.

The official city records do not indicate any further major problems in the

relationship until 1971. Sometime during that year, Delaware City initiated an effort to have the entire refinery (merged under the Getty Oil Company since 1967) annexed to the city. The effort necessitated Getty's approval, which was not granted because in Getty's opinion, the move would not be in its best interests for a number of reasons. This issue is discussed in greater detail in a subsequent chapter of this report.

Since that time, the relationship has been punctuated by grievances and incidents which have aroused the ire of people in the town toward the refinery. Several of the grievances have pertained to permits which the company neglected to secure at the proper time from city officials. They involved heavy refinery equipment brought through the town, and improvements which were made on the portion of the refinery property which lies within the municipal boundaries. Currently, there is a long-standing issue under legal review, between the company and New Castle County, to which the city is a party. It concerns the assessed valuation of Getty property, as it pertains to both County and Delaware City property taxation.

Additionally, two incidents have occurred in recent years which have raised fears on the part of town residents toward their safety and health. One incident was the disastrous March, 1978, explosion and subsequent fire that struck a jet fuel barge while it was docked at the company's marine terminal, within several hundred yards of residences and businesses. Although the incident was able to be contained through the skilled efforts of the barge company's and Getty's personnel, it awakened the fears of townspeople that something worse could happen. The other incident, which occurred in February, 1980, is frequently referred to as the "blowing silt problem." Spoils which had been dredged from Getty's river channel, and deposited at one of their spoils disposal sites near the populated part of town, turned into a powdery dust. It was blown through the town by the northerly winter winds, and created quite a nuisance. Some residents claimed that the problems created respiratory ailments; others were annoyed because of the clean-up jobs they were forced to undertake. Once they acknowledged responsibility for the problem, Getty officials moved quickly to end it. However, they did not assume full responsibility for whatever health and clean up problems the incident may have caused.

CONCLUSIONS

Throughout many of the years of Delaware City's existence prior to the construction of the refinery, there appears to have been long-lasting periods during which the town flourished. These periods occurred as the result of a richly-varied economic and cultural base, which was shaped by various people in the town from the bountiful local resources, and from certain crucial opportunities which had materialized.

Particularly during the second half of the Nineteenth century, the town was able to distinguish itself in a number of ways, including:

- as a regional shipping transportation hub;
- as a peach-growing capital;
- as an important fishing center, especially relative to the processing of sturgeon roe for caviar, which was distributed worldwide;
- as the home of several important inventions, such as the use of marl (decomposed shellfish matter) as a highly-effective fertilizer, the cold press technique for producing castor oil, and the first seamless washpan; and

- as an important military location for the defense of the Delaware River Valley.

In each of these instances, events which were largely beyond the control of the town were responsible for the demise of these sources of prominence and fortune. The coming of the railroads eroded the importance of the shipping which, because of the canal which went through the town, would have otherwise benefitted the people of Delaware City even more than it actually did. The realignment of that canal in 1927 by the Federal Government ended the town's role as a shipping hub. The peach growing which had made Delaware City famous was abruptly and cruelly terminated by a massive blight. The progressive pollution of the Delaware River, heavily caused by the Philadelphia and Camden sewage discharges, killed off the once-abundant fish populations which had provided the town with a major livelihood. Finally, the passage from times of war into times of peace (both at the time of the Civil War and World War II) eliminated the need for the two military installations at Delaware City, Fort Delaware and Fort DuPont.

By the coming of the Great Depression in the 1930's, the town was all but isolated from the region to which it had once been such an asset. Its economic base was virtually dissolved. A brief resurrection of some of its former glory occurred during World War II, as a result of the large military emplacement at Fort DuPont, immediately south of the town. By the early 1950's, the town had once again settled into a serious decline. Even the opening of the Governor Bacon Health Center in 1948, on the grounds of Fort DuPont, had failed to adequately bolster the town's flagging economy. Efforts begun in the early 1950's to spur a revival of the town were full of hope, but lacked any signs of immediate success.

This is how the town was found in 1954 by Tidewater Associated Oil Company (Getty) officials. It is difficult to dispute the assertion that their subsequent decision to erect a giant refinery at the edge of town, has brought new economic lifeblood to the community. It is also difficult to speculate on what would have happened to the town, had the refinery not been located there.

The opening of the refinery in 1957 brought a new era to life in Delaware City, characterized by the relationship which has evolved, over the years, between the town and its giant neighbor. From an examination of the interactions between the two, it is evident that their overall relationship can best be described as tentative, each cautiously wary of the other. Nevertheless, official communications back and forth have usually been diplomatically cordial, with frequent references made to their interlocking interests.

The specific beneficial and adverse effects of this relationship upon social and economic life in the community are investigated and reported in detail, in the chapters of this report which follow.

CHAPTER NOTES

1 See J. Thomas Scharf, History of Delaware 1609-1888; Delaware City: A Historic Past, A Bright Future (Elaine Derrickson and others, 1963); A Brief History of Delaware City Delaware, (Edwin A. Haugh, Jr., unpublished thesis, 1958); Elaine Derrickson's unpublished research paper on the life of Mayor Philip Reybold (1971); and Delaware City and Getty Oil: A Love-Hate Relationship (Brain P. Carter, unpublished research paper, 1982).

2 "Frankly Speaking", Wilmington Morning News (February 14, 1957).

3 18 Delaware Laws, Chapter 165 (March 31, 1887), also same as in 9 Delaware Code Section 8104 (1953 Delaware Code Annotated).

4 "Looking Around Delaware—Delaware City," Wilmington Morning News (November 22, 1935).

5 "Delaware City—Alert for New Opportunity," Wilmington Morning News (November 19, 1951).

6 Ibid.

7 Wilmington Morning News (May 25, 1957).

8 Mayor William J. Smith, letter to Mr. George Caine, Refinery Manager (May 23, 1961).

9 "Old Delaware Landmark to be Razed for Refinery," Wilmington Morning News (April 14, 1955).

10 "Widow, 90, Son to Vacate 187-Acre Farm for Oil Firm," Wilmington Morning News (June 29, 1955).

11 "Reybold Home Razed, Falls Under Torch," Wilmington Morning News (July 29, 1955).

12 "Graves on Refinery Site Those of Early Swedes," Wilmington Morning News (July 29, 1955).

13 Wilmington Morning News (July 16, 1955).

14 "Editorial," Wilmington Morning News (March 2, 1957).

15 Brain P. Carter, Delaware City and Getty Oil: A Love-Hate Relationship (unpublished paper, May 1982), p. 5.

16 "Tidewater's $200 Million Gamble," Business Week (June 15, 1957), pp 168-176.

17 Sources include New Castle County Department of Planning and the Mayor and Council of Delaware City.

18 "Wake Up, Delaware City," Wilmington Morning News (July 19, 1967).

19 Mayor and Council of Delaware City, Resolution (May 3, 1954).

[20] Ibid.

[21] Mayor William J. Smith, letter to Mr. George Caine, Refinery Manager (May 23, 1961).

[22] Wilmington Morning News (May 24, 1957).

[23] Mayor William J. Smith, letter to Mr. R. S. Stanfield, Refinery Representative (August 14, 1957).

[24] Mayor William J. Smith, letter to Mr. R. S. Stanfield, Refinery Representative (October 18, 1957).

[25] Mayor William J. Smith, letter to Mr. Walter J. Harrison, Refinery Representative (November 9, 1957).

[26] Mayor and Council of Delaware City, Resolution, (March 12, 1960).

[27] Mayor William J. Smith, letter to Mr. George Caine, Refinery Manager (May 23, 1961).

[28] Ibid.

[29] Ibid.

CHAPTER 10

COMMUNITY LEADERSHIP ASSESSMENT

INTRODUCTION

The people in a community who are elected or appointed to positions of leadership within that community, are frequently in a unique position to articulate the needs and concerns of the members of the community at large. Moreover, because of the powers, duties, and responsibilities which have been emplaced upon them, they are also in a unique position to marshall the resources available to the community toward the accomplishment of needed changes and improvements. It must be presumed, in the context of the representative democratic political system which operates throughout this country, that these leaders reflect and represent the "public will" in discharging their offices.

In Delaware City, the key positions of elected and appointed leadership include the Mayor, the members of City Council, the City Manager, and the City Secretary. As part of the conduct of the Coastal Energy Impact Program study for the community, the Consultant determined that it would be extremely valuable to receive the perspectives of these leaders relative to the relationship between the Getty refinery and the town. Since there are two sides to this relationship, it was also determined to be important to include the perspectives of the refinery's leadership. By so doing, points of agreement and shared concerns could be identified, along with areas of disagreement or counteracting interests.

An important dimension to the leadership's perceptions of this relationship, on both sides, relates to its history. This relationship, and the problems and opportunities which have come with it, has been ongoing for the past 28 years. During that period of time, both Delaware City's and Getty's leadership have changed hands a number of times. Each group of individual leaders has articulated their philosophies, stated their concerns, and taken actions which have affected the nature and quality of the relationship. These past statements and actions have had a direct bearing not only on the historical development of the relationship, but also on the nature and quality of the relationship as it is perceived today.

To ascertain current leadership perspectives, the current principal leadership of both Delaware City and Getty have been interviewed on an individual basis by the Consultant. The interviews sought to elicit three types of perceptions from each person:

- Perceptions of the nature and quality of the Getty-Delaware City relationship;
- Preceived needs and concerns from the perspective of the side of the relationship that each leader represents; and
- Perceptions of the changes and improvements which should be made to enhance the quality of the relationship, and/or to reduce or remove problems affecting either side's well-being.

In order to provide an historical perspective to the relationship, the views and actions of past leaders from both sides are also presented. While these people were not directly interviewed in all cases, their official statements and actions are part of the public record, and have been examined. They are helpful in providing a brief sketch of past circumstances which may have some bearing on currently-perceived problems and needs. Parts of this historical analysis have also been discussed in Chapter 9, History of the Getty-Delaware City Relationship.

HISTORICAL LEADERSHIP PERSPECTIVES

Delaware City Perspectives

On May 3, 1954, the Mayor and Council of Delaware City unanimously passed a resolution made by Mayor Cox that extended to the Tidewater Associated Oil Company (Getty) a ten-year remission of all town property taxes in excess of $10,000 per year, in the event that Tidewater chose to ". . .erect or set up a refinery for the processing and manufacture of petroleum products with appurtenant facilities, a portion of which is located within the limits of the Town of Delaware City . . ."[1]

This official action on the part of the 1954 Mayor and Council represents the first major expression of the perspectives of these leaders relative to the embryonic relationship between the refinery and the town. Its significance lies not only in its timing, but also in its content and in the leadership attitudes implied by this content. Essentially, the resolution implied that the Mayor and Council were quite eager to see the refinery located in and around Delaware City. Moreover, they evidently felt it to be incumbent upon themselves to pass the resolution, " . . .as an inducement to said Tidewater Associated Oil Company. . .". It is not clear from the historical record whether such an inducement was construed by the company as vital in making their decision to locate at Delaware City. However, company officials interviewed at the time of the refinery's official opening three years later in 1957, did not mention this resolution as a key factor in their decision to locate at Delaware City.[2]

Thus it appears that the 1954 resolution, which caused many subsequent hardships for the town, was not necessary, and could even be regarded as overly accommodating. Nevertheless, once passed, it became something that had to be honored by subsequent mayors and councils, even in the face of changing attitudes and conditions.

The leadership exhibited by Mayor William J. Smith during the years he presided over the Mayor and Council of Delaware City, along with the members of Council during those years, represents the next major phase in the articulation of the town's perspectives toward the relationship with the refinery. Mayor Smith is widely-perceived to have been one of the most active and effective elected leaders in the town's history. From the records available for examination, it is evident that his tenure was marked by an assertive, yet conciliatory tone in maintaining relations with officials of the refinery. For instance, it was during his first term in office that an effort was made to negate the 1954 resolution which had extended ten years of tax breaks to the refinery. While this effort was subsequently abandoned, it indicated a determination to reclaim, for the benefit of the town, a concession which had not been necessary in the first place, the constitutionality of which was questionable, and which was making it difficult for the town to finance needed civic improvements. Despite his hard line during that effort, Mayor Smith was quick to speak out, on behalf of the refinery, during a subsequent term of office, at a time when the refinery was coming under intense criticism from a number of people. His letter to George Caine, Manager of the refinery (dated May 23, 1961), enumerated many benefits which the Mayor perceived to have accrued to the town as a result of the refinery's presence. It is also noted that this letter followed the adoption of a resolution of appreciation toward the refinery, passed by the Mayor and Council in 1960.

Unfortunately, it was also during Mayor Smith's tenure that a misinterpretation of the provisions of the 1954 tax remission resolution led to some rather serious and embarrassing fiscal problems. The town sold $150,000 in bonds in 1961, to finance the

purchase and upgrading of the municipal water system. In the belief that the refinery would begin paying its full property tax payment in fiscal year 1965, Mayor Smith and the Council arranged for the first payment of principal on the bonds to be due May 1, 1965. This payment, it was assumed, would be financed in part by the additional refinery tax payment. As Mayor Earle F. Hudson (Mayor Smith's successor) was to learn by the fall of 1964, Getty's full tax payment, under the provisions of the 1954 resolution, was not due until the following fiscal year, well after the first bond payment had to be made.

The embarrassment to the town stems from the fact that the town billed the company for its full tax payment sometime during the summer of 1964. After a series of communications between refinery and town officials, Mayor Hudson formally acknowledged the error which had been made. There is little doubt that the actions of the town leadership toward Getty during this period, as unwitting as they may have been, increased the tensions in the relationship. In Mayor Hudson's letter to Mr. Walter J. Harrison, refinery representative (February 11, 1965), he took an apologetic and conciliatory tone, emphasizing the amicable relationship between the company and the town.

More recent years have been marked by alternating times of tension and harmony between the two sets of leaders. It is evident that various mayors and councils have, as a body, maintained differing postures toward their giant neighbor, ranging from a relatively aggressive or even hostile attitude to a relatively passive and accommodating one. The different bodies of leadership have, over the years, exhibited an inconsistent approach to dealing with the refinery. Despite this inconsistency, it is apparent that an air of mistrust or at least wariness, was frequently projected by these leaders of the town. The effort on the part of the 1971 Mayor and Council to persuade the refining company to allow all refinery property then in the unincorporated part of the county to be annexed to the town, brought out the mistrust and wariness felt by both sides toward each other. Several more recent incidents, involving actions or events originating at the refinery which had negative impacts on the town, have tended to reinforce the hostile attitudes expressed by town leaders.

At the same time, there has been a frequently-expressed attitude, on the part of some town leaders and other residents, that Getty has a responsibility to furnish, through contributions and other forms of corporate giving, whatever may be deficient or needed in the town. While this attitude may seem totally justified to these townspeople, it has not met a similar acceptance from Getty officials.

Getty Perspectives

The first major expression of the position of Getty's leadership during the early years of the refinery, relative to the relationship between the refinery and the town, came from George Getty, II during the opening ceremonies for the new installation in May 1957. His words, quoted in the previous chapter, espouse the "good citizen-good neighbor" posture that the company has claimed, through the years, as their guiding philosophy in dealing with the community. It is interesting to note, as was done previously, that Mr. Getty's remarks were directed to Delaware as a whole, and not necessarily to Delaware City in particular. This can be interpreted to mean that the company was, and perhaps continues to be, primarily concerned about its relations with the State government. If this is the case, then it could be supposed that any actions on the part of the company which might be offensive to Delaware City would only be of serious concern to the company if these actions were also found to be offensive to the state as a whole. This issue is important in understanding how the company defines the community to which it must be responsible as a corporate citizen.

In the years since the beginning of refinery operations, company officials have often acted and responded in ways which appear to confirm a basic attitude of paternalism, if not condescension, toward the town and its leaders. This interpretation, made through an examination of official statements over the years, does not dwell on whether refinery officials have felt they had just cause for maintaining such attitudes. It must be presumed that they did, indeed, feel that these attitudes were justified. As the relationship has developed over the years, refinery officials have probably found as many reasons to feel distrustful and wary of town leaders, as town leaders have found to feel distrustful and wary of them. From the perspective of Getty officials, the inconsistent treatment they have received from town leaders, combined with periodic outbursts of hostility and demands on the part of at least some town residents, have aroused their concern over the likelihood of maintaining a positive and cooperative relationship with the town.

In addition to the tax abatement controversies of 1957 and 1964, several controversial matters between the company and the town during the 1970's can be regarded as instrumental in reinforcing these feelings of mistrust. For instance, upon being approached in 1971 by town leaders to consider annexing into the town all refinery property in the unincorporated part of the county, the company's response was to decline the initiative. Among the reasons the company cited for their response, Mr. R. M. Hunt, Manufacturing Manager, stated: "our management will not always necessarily be dealing with a City administration having the same views as the current one."[3] The other major controversy stems from a decision on the part of town officials, sometime during the early 1970's, to increase the assessed value of Getty-owned property within the city limits, above the value established by a reassessment performed throughout New Castle County in 1971. This action resulted in higher tax bills for the refinery. For some reason, it appears that Getty officials did not question this action until sometime in 1979. By 1980, the County became involved in the dispute, and it has since been under legal review.

CURRENT LEADERSHIP PERSPECTIVES

Delaware City Perspectives

Based on a series of individual interviews and informal discussions with the members of the current Mayor and Council of Delaware City, the former and current City Managers, and the City Secretary, the Consultant has been able to identify two distinct orientations among these leaders, relative to their perceptions of the relationship between the town and the refinery. These orientations are outlined below, in terms of the distinct ways that they reflect a perception of the nature and quality of the relationship, including perceived problems or weaknesses in it, and an identification of areas needing improvement. For this purpose, the two orientations are identified as the opposition orientation and the cooperation orientation. The two are not necessarily mutually exclusive, but the various members of the current leadership do appear to favor one versus the other.

Opposition Orientation

This orientation has been so-named because it embodies a rather consistent opposition to the presence of the refinery and to all or most requests made by the company to the town, in matters requiring the city's permission or cooperation. While it appears that only a minority of the current leadership represents this orientation, it has

been more predominant in past times and continues to be shared by a relatively small, but vocal, segment of the community. It is shared principally by people who have resided in the town for all or most of their lives and who were adults at the time the refinery was initially developed.

The opposition contingent maintains that the refinery does not adequately benefit the town and, in fact, has been responsible for the loss of certain resources and features which were of significant value to the community. Perpetual odors and pollution which have emanated from the refinery over the years, in the face of meager employment opportunities for town residents and inadequate levels of other potential benefits, have combined to sustain the perspectives of this contingent. Certain other incidents over the years, including oil spills, fires, explosions, blowing silt, and unauthorized construction activities on property within the town, are pointed to as evidence that the refinery and its officials cannot be trusted to operate in a manner compatible with the well-being of the community. Finally, it is felt by town leaders and other residents who share this orientation, that Getty should assist the town with its financial and other needs to a much greater extent than has historically been the case.

Cooperation Orientation

This contingent, comprising a majority of the current leadership, acknowledges that relations between the town and the refinery have often been strained. Moreover, it is felt that the inconsistency with which the town has related to the refinery over the years, is a problem itself. These leaders believe that the basis must be established and maintained to provide for a more consistent approach toward the company predicated on mutual openness and trust. Only in that way, it is felt, can the town hope to receive greater cooperation and support from the company. This contingent also recognizes that both the refinery and the town are going to continue to exist for a long time and, therefore, will have to continue to deal with each other.

The cooperation orientation acknowledges the problems and concerns which exist in the relationship, but it is felt they can be resolved through a positive, cooperative approach. Therefore, it is an orientation which contains some measure of optimism and hope. The key problems and concerns, beyond the inconsistency which has historically characterized the town's dealings with the refinery, include:

- continued concerns about air pollution and odors;
- concern about the adequacy and effectiveness of city regulatory controls, relative to Getty land use activities in the portion of their property which is within the town limits; and
- interest in attaining a greater level of community involvement and support from Getty, voluntarily contributed by the refinery in the context of mutually-beneficial and harmonious relations.

Getty's recent tax payment to the city, paid well in advance of when it was due to help the city's finances, is pointed out as a positive result of the current cooperative spirit which has developed between the town and the company.

Getty Perspectives

The perspectives of the Getty refinery leadership are, at any one time, relatively monolithic, since these perspectives stem primarily from the orientation of one person—the person who is filling the position of Plant Manager. Under current corporate

arrangements, the person filling this position, Mr. Ray Arzinger, is also a Vice President of the Getty Refining and Marketing Company, a subsidiary of the Getty Oil Company. It is, presumably, the responsibility of the person filling this leadership position to represent the philosophies and views of the executive levels of the parent corporation. Mr. Arzinger was interviewed by the Consultant on May 28, 1982, to ascertain the perspectives of the corporate leadership relative to the refinery's relations with the town.

It has been the consistently-stated position of this leadership that the refinery has a responsibility to be a "good corporate citizen". It is pointed out that this responsibility is felt most deeply in maintaining positive relations with the State and Federal governments. However, it is acknowledged that this responsibility also applies to relations with Delaware City, and that these relations have admittedly been neglected by the company in the past. The company leadership feels that the refinery has provided important benefits to the community over the years—as a taxpayer, as an employer, as a charitable contributor, and as a source of other economic stimulation. This leadership also maintains that had the refinery not been located in Delaware City, the other petrochemical companies adjacent to the refinery would not have located there either. Together, the refinery and these "satellite" facilities have created 2,000 employment opportunities for the community at large.

The management of the refining company consider themselves sincere in meeting all tax obligations, as long as it is felt that these taxes are equitably administered. With respect to their financial support of Delaware City, the leadership is opposed to the notion of making gifts toward the support of basic municipal operations which, it is felt, should be financed strictly through the city's fiscal management process. However, the company does have a corporate giving policy and program, geared primarily to the arts, health, and education. For the purposes of corporate giving, the company favors those projects with a maximum benefit to people within proximity of company installations.

The current leadership feels that the company has not always been approached and treated by the town with consistency, honesty, and a cooperative spirit. It is felt that the town leadership has, on occasion, reneged on agreements which have been made with the company. On other occasions, it is felt, town leaders have clandestinely opposed company efforts to expand or make improvements. These instances have combined to become points of contention and ill-will in relations between the company and the town. The company leadership feels that current relations are more cooperative than in the past, and it is hoped that this mood of cooperation will continue. The company's major concerns relative to their treatment by the town encompass the desire for fair treatment on tax matters and cooperation from the town when the company seeks governmental approvals for its actions through legitimate channels.

CONCLUSIONS

As stated earlier, both Delaware City and the Getty refinery are likely to continue to exist, side by side, for many years to come. The relationship which has developed between the two has been frequently tense and guarded over the years, interspersed by periods of cooperation and harmony. This relationship is manifested primarily in the attitudes and actions of the leadership of both sides; in particular, the Mayor and Council on behalf of Delaware City, and the refinery's management on behalf of Getty. The leadership on both sides has changed a number of times over the years, and with these changes, there have been variations in the nature and quality of the relationship.

One realization is well-evident: the town has needs which must be satisfied by the company, and the company has needs which must be satisfied by the town. In addition, it is evident that there are matters over which the two can potentially achieve mutually-beneficial results.

In light of these realizations, it becomes clear that the establishment of a more consistent relationship, characterized by mutual trust, honesty, and a recognition of each other's needs, will provide a more effective basis for the achievement of these mutually-beneficial results. However, this trust, honesty, and recognition of each other's needs cannot simply be given lip service, as appears to have been the case in the past. Rather, these feelings must be sincere and must become rooted in positive, substantive areas of agreement and shared purpose. Unless or until this can be accomplished, the relationship will probably continue to be plagued by mistrust and bickering on both sides.

One possible vehicle for articulating and maintaining a commitment to a strengthened and positive relationship, stems from an idea suggested by one member of the Delaware City Council. It would involve the execution of a formal statement of understanding, such as a compact, entered into by both parties, perhaps executed to become renewable every several years. This statement could be formulated to establish all areas of shared purposes and interests, and also to establish formalized procedures for maintaining communications and resolving conflicts. It is recommended that the leaders of both sides seriously consider this suggestion.

CHAPTER NOTES

1 Mayor and Council of Delaware City, Resolution (May 3, 1954).

2 News Journal Papers, May 25, 1957.

3 R. M. Hunt, Manufacturing Manager, in a letter to the Mayor and Council of Delaware City (May 19, 1971).

CHAPTER 11

HEALTH IMPACTS

INTRODUCTION: THE RELATIONSHIP BETWEEN POLLUTION AND HUMAN HEALTH

Previous chapters of this report have presented the findings and conclusions of the impact of the Getty refinery upon various resources of interest to Delaware City residents. Two of these resources, air quality and water quality, are extremely important relative to the health of people in the community. Unfortunately, it is usually extremely difficult to relate specific types and levels of pollutants found to be present in the ambient air or water environments, to specific types of illness or mortality among people residing near the sources of these pollutants. This is generally true even with the availability of comprehensive data on pollution levels and the health and death records of nearby residents, and despite the fact that repeated tests on laboratory animals have demonstrated the carcinogenic (cancer-causing) properties of various pollutants.

The problem in making the link between laboratory research and the daily human environment is three-fold.[1] For one thing, laboratory tests are usually conducted with animal species which are much smaller than humans, and which have life processes that are often appreciably different. Secondly, these animals are given direct dosages of whichever pollutant-chemicals are being tested, over relatively short time intervals. In contrast, in real life, humans are usually subjected to pollutants in much smaller, less direct dosages, but over relatively long time intervals. Thirdly, the presence of pollutants is only one of a number of factors which have the potential to create health disorders. In real environments, these factors are frequently present in multiple combinations and include heredity, age, sex, race, stress, cigarette smoking, eating habits, population density, occupation, and climate, in addition to the existence of air or water pollution.[2] However, in laboratory situations these other factors are either absent or systematically controlled. Nevertheless, laboratory research remains as the primary source of information which is used to formulate pollution control regulations, and is still regarded by experts as the most practicable means of understanding the impact of pollution on human health.[3] The only alternative method currently known involves the use of epidemiological analysis, through which the medical case histories of the residents of a particular area are correlated with data on the presence of pollution and other factors. This method, while much better grounded in the real life environment, is still at an early developmental stage. Moreover, it requires substantial funding, time, and expertise, and these requirements are usually not easy to meet.

Even when the connection between the presence of specific pollutants and the occurence of specific ailments and causes of death has been established to be statistically significant, tracing the sources of this pollution is still very difficult in most cases. This has only been successfully accomplished in a few instances, usually involving a particular group of workers who have been directly exposed to a particular substance, as in the cases of asbestos plant workers and coal miners.

Despite the above-mentioned problems of establishing direct causality for various illnesses and types of mortality, there is abundent evidence, compiled through numerous studies, to conclude that a relationship does exist between exposure to air and water pollution and human health. In fact, this evidence has been adequate to justify, and provide the basis for, governmental regulation and control of pollution over the past several decades. Certain diseases have been identified as definitely being pollution-related, in particular, various forms of cancer, cardiovascular disease, and various respiratory ailments. Since the incidence of these diseases often results in premature death, a corresponding relationship between pollution and excess mortality has also been established. Some of the most prominent findings concerning the pollution-human health relationship are summarized below:

1. The health effects of numerous chemicals and chemical compounds frequently found in pollution have been estimated, based on laboratory and epidemiological research. Work has been done to identify the effects of both short-term, high dosages and long-term, low dosages.[4] Despite the fact that much of this research has utilized non-human animal species in laboratory settings, inferences to humans can be defensibly made, especially when cancer is involved.[5]

2. Historical analyses have demonstrated that instances of exposure to extremely high levels of air pollution have resulted, even during short time periods, in excessive cases of respiratory ailments and excess mortality. The classic pollution episodes from which these analyses have been drawn, include: Belgium (1930); Donora, Pennsylvania, (1948); London, England, (at least eight episodes between 1837 and 1962); New York City (1963); and Los Angeles.[6]

3. A landmark analysis of mortality rates in 117 Standard Metropolitan Statistical Areas (SMSA's) in the United States between 1960 and 1969, concluded that exposure to air pollutants is significantly correlated with excess mortality. The study also investigated the extent to which other factors contribute to mortality.[7]

4. At least three major studies have concluded that there is a relationship between the occurrence of refinery air pollution, health damage, and excess mortality. This relationship has been found to exist in the context of continuous pollution over relatively long periods of time. Studies have been conducted in Yokkaichi, Japan,[8] Los Angeles County, California,[9] and a selected group of 39 United States counties in which petroleum manufacture was a major source of employment.[10]

5. One specific group of chemical compounds emitted by oil refineries, known as polycyclic aromatic hydrocarbons (PAH), has been identified as contributing to cancer at ambient air dosages. Non-smokers have been found to be slightly more prone to cancer mortality, but the more serious effects occur in conjunction with the effects of smoking.[11] PAH are transported through the air in the smaller-sized particles that refineries emit.[12] While pollution control monitoring equipment is widely used to measure the quantity of particulate matter, it cannot effectively distinguish the size of individual particles. It has been found that 60 percent of all inhaled particulate in the size range 0.5-2.0 microns becomes embedded in the lung (one micron = 0.001 millimeter).[13]

To date, no study has been conducted which would seek to establish the connection between air or water pollution and disease or death anywhere in Delaware. The closest thing to this kind of study that involved Delaware was the study of 117 SMSA's, conducted by Lester Lave and Eugene Seskin, which included the Wilmington, Delaware, SMSA. Unfortunately, none of the data for Wilmington was presented separately in the published report of their study.

In fact, the only epidemiological research that has been conducted for the State and its three counties is limited to cancer. This study, completed by the Delaware Cancer Reporting Service, primarily analyzed the incidence of ten major types of cancer in Delaware, and the related survival rates.[14] While no effort was made to identify the potential causes of the reported cancer cases, the study is nonetheless a signficant advancement in epidemiological research in the State. Some of the study's findings are presented in the following pages.

These glaring deficiencies in the availability of comprehensive epidemiological

records and data for Delaware and its subdivisions will hopefully be reduced in the next several years. Despite the tremendous improvements in the reporting of cancer cases, especially since 1978, much work remains to be done. For example, one of the stated objectives of the (former) Delaware Cancer Network, now operated under the auspices of the Wilmington Medical Center, was:

> "To identify high-risk populations and make available to them high quality detection, diagnostic, and treatment services through their usual sources of primary medical care."[15]

To date, no known report which identifies high-risk populations has been compiled. Furthermore, there is a compelling need for the establishment of similar comprehensive reporting procedures relative to other commonly contracted diseases, such as cardiovascular diseases and respiratory diseases. This need has been emphasized by State medical experts.[16]

In the absence of specific analyses which would identify the connection between air or water pollution exposure and the incidence of diseases and excess mortality among residents of Delaware communities, no conclusions can be made about the health impacts of industrial activities such as the Getty refinery.

At the same time, currently available mortality and epidemiological data can be used as indicators to discuss the general health of Delawareans, New Castle Countians, and to a limited extent, the residents of Delaware City. This sort of discussion is valuable toward an understanding of trends in disease incidence and mortality, so that issues requiring further investigation can be pinpointed. The following pages present a discussion of what is currently known about the health of area residents, and includes information on:

* Trends in cancer mortality in Delaware;
* Cancer incidence rates in New Castle County, and comparisons with other parts of the United States;
* Hospitalization and death rates for Delaware City; and
* Cancer cases in Delaware City.

TRENDS IN CANCER MORTALITY FOR DELAWARE

Although the reporting of the incidence of cancer in Delaware has been inconsistent and unreliable until relatively recently, records of cancer mortality have been uniformly reliable for many years. The death of Delawareans as a result of cancer has been increasing at a disturbingly high rate during this century. This is evident through an examination of death statistics using two distinctly different methods. One method is to examine trends in the cancer mortality rate, i.e., the number of recorded cancer mortalities per 100,000 people. In 1928, the Delaware cancer mortality rate was determined to be 103 deaths per 100,000.[17] By 1960, the rate had increased to 159, and reached 182 by 1970. The 1970's have brought still more increases in the rate: in 1978, it stood at 218. Since this statistic is given as a rate per 100,000 people, it adjusts for all changes in the population size. The only important demographic factor it does not adjust for relates to changes in the age distribution of the population (frequently, cancer

mortality rates are age-adjusted). However, it is unlikely that age explains very much of the increases: the median age of the population, while having fluctuated slightly in both directions, has remained relatively constant. Moreover, the proportion of the population age 65 and over increased only slightly between 1930 and 1970, from 7 percent to 9 percent (a 14 percent increase in the proportion), while the cancer mortality rate increased by 77 percent during the same period. Even between 1970 and 1978, when the proportion of people 65 years and older increased to 9.3 percent of the popluation (a 16 percent increase from 1970), the jump in the cancer mortality rate was still more substantial, reflecting a 20 percent increase from 1970.[18]

Another method of demonstrating the historical increase of the cancer mortality problem is to compare it with trends in the other major cause of death for Delawareans—heart disease. While heart disease continues to be the number one killer in the State, the proportion of total deaths that it contributes has remained almost perfectly constant since 1955, approximately 46 percent of all deaths. The actual number of heart disease deaths has increased at an average annual rate of 1.15 percent. Meanwhile, cancer-related deaths have been accounting for an ever-greater proportion of total deaths since 1955—from 17 percent in that year, to 29 percent in 1978. Furthermore, the actual number of cancer deaths has been increasing at an average annual rate of 3.57 percent. This is not only much higher than the annual increase in heart disease deaths, it is also much higher than the annual increase in total deaths (average annual increase rate 1955-1978 = 1.19 percent).

CANCER IN NEW CASTLE COUNTY

If cancer is a problem for the state as a whole, it is even a more serious problem in New Castle County. This realization comes as no surprise to health experts, because of the fact that New Castle County is the state's most heavily industrialized, urbanized county.[19] Records on cancer mortality for the County, readily available only for 1978, show the County's cancer mortality rate was more than twice the rate for the United States as a whole for that same year.[20] In addition, there is comprehensive data on cancer incidence, including survival rates, as the result of the Delaware Cancer Reporting Service's reporting and analytical efforts.

The Delaware Cancer Reporting Service has calculated age-adjusted average annual cancer incidence rates per 100,000 people, for ten of the most common cancers, for Delaware as a whole and for each of the three counties. These rates, based on reported cases between 1977 and 1979, can be compared with incidence rates in other parts of the United States, which have been calculated through the National Cancer Institute's Surveillance, Epidemiology, and End Results (SEER) Program.[21] The SEER Program is a broad-based cancer registry program which receives records from 11 regional registries in addition to Delaware, including: Connecticut; Hawaii; Iowa; metropolitan Atlanta; metropolitan Detroit; metropolitan New Orleans; New Mexico; Peurto Rico; San Francisco-Oakland; Seattle-Puget Sound; and Utah. These areas include a selection of heavily-industrialized and heavily-urbanized areas combined with rural areas, and represent a cross-section of climatological and geographical differences.

When cancer incidence rates for New Castle County are compared with these other areas as a group, the County has higher rates for all but three cancer sites, as shown in Table 18. It is interesting to note that the three sites for which the County's rates are lower, are all sex-specific cancers. Table 18 also indicates that lung and breast cancers are particular problems for the County.

TABLE 18

AVERAGE ANNUAL AGE-ADJUSTED (1970 U.S. STANDARD) INCIDENCE RATES PER 100,000 POPULATION, FOR TEN COMMON CANCER SITES

Sites	New Castle County 1977-79	National Cancer Institute SEER Areas 1973-77
All Sites	358.8	331.5
Lung	60.1	51.4
Breast[1]	92.4	83.7
Colon	42.9	35.3
Prostate[2]	57.5	75.3
Rectum	20.5	15.1
Bladder	17.2	15.6
Uterus[1]	19.7	26.2
Cervix[1]	32.4	48.9
Lymphomas	12.7	12.7
Melanoma of the skin	8.7	7.1

Notes: 1 Rate per 100,000 females

2 Rate per 100,000 males

Sources: Delaware Cancer Reporting Service

National Cancer Institute

William J. Cohen and Associates, Inc.

Even when New Castle County is compared with five of the eleven NCI-SEER areas which are known to be heavily-urbanized and industrialized, the County's incidence rates for most forms of cancer are still either the highest or second-highest among these comparable areas. The areas include: Detroit, MI; Atlanta, GA; San Francisco-Oakland, CA; Seattle-Puget Sount, WA. Three of these five areas are within close proximity to major petroleum refinery installations. Table 19 below shows how New Castle County compares with each of these areas, and with these areas as a group.

The results of these comparisons point to a significant and justifiable concern for the health of New Castle Countians. Cancer incidence can be regarded as an important indication of a population's health. As discussed earlier, cancer is the second largest killer in Delaware (as well as in most other parts of the United States), and is claiming an

TABLE 19

AVERAGE ANNUAL AGE-ADJUSTED (1970 U.S. STANDARD) INCIDENCE RATES PER 100,000 POPULATION, FOR TEN COMMON CANCER SITES, SELECTED URBANIZED AREAS

	New Castle Co. 1977-79	Detroit 1973-77	Atlanta 1975-77	New Orleans 1974-77	San Fran.-Oakl. 1973-77	Seattle 1974-77	All Five[1] Areas
Development Status[2]	U, I, R	U, I	U	U, I, R	U, I, R	U, I, R	———
Cancer Sites							
All Sites	358.8	327.0	335.2	337.2	363.5	350.1	342.7
Lung	60.1	50.8	48.9	63.4	52.6	50.1	51.9
Breast[3]	92.4	81.7	87.3	76.2	96.0	89.3	87.0
Colon	42.9	32.5	31.0	32.0	35.4	32.7	33.1
Prostate[4]	57.5	66.4	86.2	68.9	71.9	83.1	73.8
Rectum	20.5	14.4	11.7	13.7	15.2	15.0	14.3
Bladder	17.2	15.2	13.0	15.6	15.0	16.5	15.2
Uterus[3]	19.7	26.4	25.7	12.9	40.6	41.9	31.8
Cervix[3]	32.4	49.9	71.9	37.7	51.0	72.5	56.2
Lymphomas	12.7	11.2	10.5	10.7	13.0	12.6	11.8
Melanoma of the skin	8.7	3.5	8.2	4.7	8.4	7.1	6.1

Notes for Table 19

[1] Calculations represent weighted averages based on population sizes.

[2] U = Urbanized, I = Industrialized; R = Petroleun Refineries

[3] Rate per 100,000 females

[4] Rate per 100,000 males

Sources: Delaware Cancer Reporting Service

National Cancer Institute

William J. Cohen and Associates, Inc.

---

increasing proportion of all deaths with the passage of each year. It is significant that lung cancer, in particular, is higher in New Castle County than in four of the five other urbanized and industrialized areas with which it was compared, exceeded only by the San Francisco-Oakland area. Lung cancer is a disease which has been frequently associated with exposure to air pollution.

HOSPITALIZATION AND DEATH RATES IN DELAWARE CITY

In the absence of a comprehensive epidemiological study of the health of Delaware City residents, few specific conclusions can be drawn concerning the health of the community.[22] However, there are certain factors which can give a general picture of the community's health. These factors are discussed in this and the following section.

One indicator of a community's health is revealed by the relative number of hospital admissions involving members of the community. This number can be converted to a hospitalization rate, which can be compared with that for another group of people, while automatically adjusting for population size differences. This indicator is very general, because not all hospital admissions reflect a serious health problem—births, tests, and minor surgery, for example, do not represent serious health problems. Ideally, an analysis of health-indicative hospital admissions should focus on medical/surgical admissions. Unfortunately, such records are not readily accessible relative to Delaware City. Nevertheless, the vast majority of all hospital admissions can be assumed to involve serious illnesses and accidents.

When compared with New Castle County as a whole, Delaware City's hospitalization rates appear to be high. Table 20 shows these rates, along with population and admissions numbers, for the two jurisdictions. Admissions have included reports from all major private hospitals in the State.

TABLE 20

HOSPITAL ADMISSIONS, 1978

	Delaware City	New Castle County
Admissions	260	35,558
Population[1]	1,891	396,658
Hospitalization Rate (per 1,000 population)	137.5	89.6

Notes: [1] Based upon Estimates of 1978 populations.

Source: Health Plan for Delaware, 1980-1985, Volume II, Table C-19.

While Delaware City's hospitalization rate is 53 percent higher than New Castle County's, it must be considered in view of the fact that Delaware City had a 48 percent higher proportion of persons of age 57 and above in 1970.[23] The survivors of this age group would have been 65 years or older by 1978, and could conceivably explain most of the difference in hospitalization rates, since age is a major factor in the need for hospital care.

Another indicator of the relative health of Delaware City residents can be ascertained from mortality rates. Mortality records were obtained for Delaware City and compared with records for New Castle County. In both cases, total deaths were examined, since data on deaths by cause are difficult and expensive to retrieve. Table 21 provides information on the number of deaths, estimated population, and mortality rates for the two jurisdictions, for the years 1975-1978.

TABLE 21

DEATHS FROM ALL CAUSES, 1975-1978

	1975	1976	1977	1978	1975-1978 Average
Delaware City					
Deaths	15	21	16	25	19.25
Population	1,941	1,924	1,908	1,891	1,916
Mortality Rate (per 1,000 population)	7.7	10.9	8.4	13.2	10.05
New Castle County					
Deaths	2,871	2,964	2,932	3,034	2,950
Population	399,354	400,937	398,488	397,678	399,114
Mortality Rate (per 1,000 population)	7.2	7.4	7.4	7.6	7.4

Sources: Delaware Office of Management, Budget and Planning, Dimensions on Delaware: A Statistical Abstract for 1979.

Census and Data System, College of Urban Affairs and Public Policy, University of Delaware.

The mortality records were not sufficiently detailed to permit any adjustments for the age characteristics of the two populations. Therefore, it can be argued that the greater propotion of senior citizens in Delaware City accounts for most of the 36 percent higher average mortality rate, as was done with the hospitalization rates. However, age differences do not appear to account for all differences, because in 1978 the age group with the greatest number of deaths in Delaware City was 55 to 64 years old. This age group made up a higher proportion of New Castle County's population than its proportion of Delaware City's population.[24] Thus, at least for 1978, age alone cannot explain the extraordinarily high mortality rate in Delaware City.

CANCER IN DELAWARE CITY

As mentioned previously, detailed epidemiological records on the incidence of cancer among Delaware City residents were not available for the purposes of this report.[22] Until these records are retrieved and carefully analyzed, no specific conclusions can be made about the extent of the cancer problem among town residents.

Based on the efforts of Mrs. Ann Pichett and Mrs. Nan Kirk of the Delaware City Health Clinic, operated by the Visiting Nurses Association, a preliminary list of cancer victims has been developed. The list includes all town residents who have been diagnosed as having cancer and/or have died of cancer, during the period 1970-1982. At the time of the writing of this report, 40 residents had been identified as cancer victims.

While this effort is an important beginning, much more information is needed about these and any other residents who have developed the disease. For example, information on age at diagnosis, year of diagnosis, age at death and year of death (if applicable), specific cancer sites diagnosed, smoking habits, occupational histories, family cancer histories, and a number of other items must be uncovered in order to formulate any specific conclusions about the cancer problem in Delaware City. Even then, no connections could be made between cancer and air pollution without the analysis of extensive information on air quality in the town. Since the measurement of air quality is a relatively recent practice, and cancer can take up to several decades to develop in an individual, the task would be formidable, if not impossible.

CONCLUSIONS

Based upon existing information and analysis, no direct connections can be made between the health of Delaware City residents and their exposure to air pollution. The health impacts of any specific source of pollution, such as the Getty refinery, are even more difficult to identify. This dilemma confronts not only Delaware City, but New Castle County as well. It is even arguable that the same dilemma exists throughout the United States, since every effort to pinpoint the long-term health effects of pollution from specific sources has been disputed by corporate interest groups who represent these sources.

Despite these limitations, several concluding observations can be made about the pollution-human health connection, relative to concerns about the health of New Castle Countians and residents of Delaware City. These observations follow.

1. Several pioneering efforts have utilized statistical analysis to establish a significant relationship between human health and exposure to air pollution from industrial sources in general, and petroleum refining in particular. These studies have investigated conditions in Yokkaichi, Japan; Los Angeles County, California; and a group of 39 U.S. counties in which refineries make up a significant share of economic activity. While the impact of these findings has been disputed by health experts associated with the petroleum industry (except in Japan), it must be concluded that these studies raise some serious issues which need to be further examined.

2. Cancer, a disease category more frequently associated with exposure to air pollution than most other diseases, appears to occur at excessively high rates in New Castle County. This is true no matter whether the county is compared with a cross-section of other areas around the country, or with a group of areas exhibiting comparable urbanization and industrialization characteristics, including the presence of petroleum refineries. Furthermore, cancer mortality, i.e., actual death caused by cancer, is at a generally higher rate in New Castle County than for the U.S. as a whole, registering 191 deaths per 100,000 population in the County in 1978 as opposed to approximately 80 deaths per 100,000 population for the U.S.[25]

3. Virtually no analysis of disease and mortality rates among Delaware City

residents has been done to date, especially for diseases frequently associated with air pollution exposure, such as cancer, cardiovascular disease, and respiratory disease. The existence of a multi-firm petrochemical complex in close proximity to the town, including the Getty refinery, makes the need for such analysis justifiable. An initial review of hospitalization and mortality rates for Delaware City residents indicates that these rates are as high as, or higher than, comparable rates for New Castle County. In turn, New Castle County is suspected of having excess cancer mortalities when compared with other parts of the U.S. One hypothesis which can be formulated based on the available evidence, is that Delaware City experiences the same health problems as the entire County. It can further be hypothesized that air pollution being generated at the petrochemical complex adjacent to the town, may be contributing to health problems throughout a major part of the County, since meteorological conditions tend to distribute this pollution over much of the area. Comprehensive epidemiological research and analysis is needed in order for these hypotheses, and others, to be tested in a statistically sound manner. Until this is accomplished, no further conclusions can be made concerning the health-related impacts of specific industrial activities such as the Getty refinery.

RECOMMENDATIONS

There are three recommendations concerning actions which can be taken by the Mayor and Council of Delaware City, in conjunction with other interested groups, relative to health issues. They are as follows:

1. Funding and technical assistance should be sought toward the undertaking of a comprehensive epidemiological study for the community. Such a study would be capable of demonstrating whether any unusual or significant health problems exist among residents of the town. The basis would then be established for pursuing the sources of any identified problems. Possible sources of funds and/or technical assistance include:

    - Delaware Cancer Reporting Service, Wilmington Medical Center (potential source of technical assistance)

    - Delaware General Assembly (potential funding source)

    - American Cancer Society, Delaware Chapter (potential source of technical assistance and funding source)

    - Division of Public Health, Delaware Department of Health and Social Services (potential source of technical assistance)

    - National Cancer Institute (potential funding source)

2. An information and recordkeeping system should be established and/or expanded to maintain the medical histories and other pertinent information for all town residents who have been diagnosed as having cancer, cardiovascular disease, or respiratory disease. The health clinic operated by the Visiting Nurses Association in Delaware City provides an excellent mechanism for the establishment of such a system, but would probably require additional staff support to undertake such a task. Based upon budgetary needs, additional financial support or contributions should be sought to accomplish this effort.

3. A survey of all households in the community should be conducted in order to identify persons with a potentially high risk of contracting cancer. Such a survey should be accompanied by a highly-visible educational campaign. Technical assistance from the American Cancer Society, Delaware Chapter, may be available to support this undertaking.

CHAPTER NOTES

1 Maurice Frankel, The Social Audit Pollution Handbook, pp. 9-10.

2 The importance of some of these non-pollution factors was studied by Lester Lave and Eugene Seskin in their study, Air Pollution and Human Health.

3 A. W. Pucknat, ed., Health Impacts of Polynuclear Aromatic Hydrocarbons.

4 Charles T. Stewart, Jr., Air Pollution, Human Health, and Public Policy (pp.17-34).

5 Maurice Frankel, The Social Audit Pollution Handbook, pp. 6-10.

6 Gregg Kerlin and Daniel Rabovsky, Cracking Down: Oil Refining and Pollution Control (Council on Economic Priorities, 1975), p. 87.

7 Lave and Seskin, pp. 235-237.

8 Gregg Kerlin and Daniel Rabovsky, Cracking Down: Oil Refining and Pollution Control (Council on Economic Priorities, 1975), p. 8.

9 H. R. Menck, J. T. Casagranda, and B. H. Henderson, "Industrial Air Pollution: Possible Effect on Lung Cancer," Science magazine, (1974, #183, p. 210).

10 W. J. Blot, L.A. Brinton, J. F. Fraumeni, Jr., and B. J. Stone, "Cancer Mortality in U. S. Counties with Petroleum Industries", Science Magazine, October 7, 1977, pp. 51-53.

11 Jos. F. Fraumeni, Jr., Ed., Persons at High Risk of Cancer: An Approach to Cancer Etiology and Control, pp. 230-234.

12 A. W. Pucknat, ed., Health impacts of Polynuclear Aromatic Hydrocarbons, pp. 114.

13 Ibid, p. 115.

14 Delaware Cancer Reporting Service, Incidence and Survival Rates of Most Common Cancers in Delaware, 1972-1979 (February 1982).

15 Thomas C. Fedewa, PhD., "Delaware Cancer Network—A Review and Update," Delaware Medical Journal (August 1976, p. 445)

16 Bureau of Health Planning and Resources Development, Delaware Health Data Plan, November 1980 (Division of Public Health, Department of Health and Social Services, 1981).

17 Thos. C. Fedewa, PhD., "Delaware Medical Journal (March 1978, p. 131.)

18 Computations are based on mortality and demographic data available in Dimensions on Delaware: A Statistical Abstract for 1979 (Delaware Office of Management, Budget and Planning, September 1980), pp. 22 and 45.

19 Delaware Cancer Reporting Service, Incidence and Survival Rates of Most Common Cancers in Delaware 1972-79 (February 1982), p. 34.

[20] Rates are based on data furnished in National Cancer Institute's Monograph 59, Cancer Mortality in the United States: 1950-1977 and Delaware Office of Management, Budget and Planning, Dimensions on Delaware: A Statistical Abstract for 1979.

[21] National Cancer Institute, Monograph 57, Surveillance, Epidemiology, and End Results: Incidence and Mortality Data 1973-1977. (National Institutes of Health, U.S. Public Health Service, Department of Health and Human Services, June 1981).

[22] The records and data necessary to conduct such a study are available. However, the time and funding which would be required were not justifiable within the scope of this report.

[23] Estimates are based on age distribution data from the 1970 Census.

[24] See note 23 above.

[25] Rates are based on data furnished in National Cancer Institute's Monograph 59, Cancer Mortality in the United States: 1950-1977, and Delaware Office of Management, Budget and Planning, Dimensions on Delaware: A statistical Abstract for 1979.

CHAPTER 12

SOCIO-ECONOMIC IMPACTS

INTRODUCTION

When a major industrial complex locates near a small community, significant changes in the social and economic fabric of the community are often expected. In the case of the Getty refinery locating in and around Delaware City, it is difficult to determine what were the expectations and what were the fantasies. Apparently, at least some people in town were under the impression that the oil refinery would create a newly-prosperous community due to new employment opportunities, population growth, investment, tax revenue, and other, more indirect economic spin-off benefits. Whatever the expectations were, the fact is that between 1960 and 1970 Delaware City appears to have regressed in relative terms, and in some cases absolute terms, when compared to New Castle County and the State on the basis of common socio-economic variables. (Data from 1950 and earlier, which would have proved instructive, was not compiled by the Bureau of the Census at the time for a community as small as Delaware City, and 1980 census data for these detailed characteristics is not yet available). Obviously, no clear lines of responsibility can be drawn between the refinery and the socio-economic trends, but one thing is clear: no real increase in prosperity has accrued to the town or its citizenry since the refinery came in the mid-1950's.

Following a presentation of several key indicators of the socio-economic trends in Delaware City over the past few decades, and a comparison of Delaware City's 1970 socio-economic characteristics with the characteristics of surrounding areas, the impacts on the town's economy which can be attributed to the operation of the refinery, will be discussed. Due to the incompleteness of available information on refinery-related employment of town residents, earnings information, and data on commercial trade volumes experienced by businesses located in the town, these impacts are, for the most part, "best estimates." Nevertheless, they are based on the most complete and up-to-date information available for a community of Delaware City's size, and have involved the use of accepted estimation techniques. All major assumptions and qualifications which might affect the accuracy of these estimates, are stated.

SOCIO-ECONOMIC TRENDS

As mentioned above, basic trends in the growth or change of a community's social and economic fabric can be assessed by examining certain indicators which are commonly available through census data and other demographic surveys. Unfortunately, the bulk of this data was not collected for Delaware City until the 1960 census, and therefore no examination of trends during the 1950's can be made (it was during that decade that the refinery was built and began operating). Also, data from the 1980 Census, with the exception of preliminary population and housing counts, has not yet been made available, and therefore no examination of trends during the 1970's can be made. However, data from the 1960 and 1970 Censuses provides the opportunity to examine these trends for the decade of the 1960's. It was determined that an examination of trends during that decade would be instructive for two reasons: (1) the Getty refinery was in full operation during the entire decade; and (2) a number of "satellite" industries, most of which are primarily engaged in the production of petrochemical products or related services, located adjacent to the refinery and began operations during the decade.

To summarize pertinent socio-economic trends during the period 1960-1970, the following findings are presented:[1]

1. Median family income in Delaware City rose by 24.2 percent, while rising 39.6 percent for all of New Castle County and 64.8 percent in the State of Delaware.

2. In Delaware City, the number of families earning $10,000 or more per year increased by 23.2 percent during the decade, compared to a 33.8 percent increase in New Castle County, and a 31.9 percent increase in Delaware.

3. Median school years completed declined in Delaware City during the decade by 0.2 years, while increasing by 0.7 years in the County, and 1.0 years in the State. In Delaware City, 6.6 percent fewer persons completed a high school education, while in the County and the State, there were increases of 11.2 percent and 11.4 percent, respectively.

4. The size of the labor force as a percentage of the total population decreased in Delaware City while increasing in the County and the State, despite the fact that the actual number of employed people in Delaware City increased by 22.4 percent (the County's increased by 30.6 percent and the State's by 30.7 percent).

5. The employment of Delaware City residents in construction and manufacturing was 18.4 percent lower, and white collar employment was 5.5 percent lower in 1970 than in 1960. Retail trade and professional services were the largest-gaining employment sectors.

6. The total population of Delaware City has fluctuated in recent decades. In 1950, the official population of Delaware City was 1,363. By 1960, the population had grown to 1,658, and by 1970, the total population reached 2,024. However, the 1980 Census reveals that the Delaware City population has dropped to 1,862. There is no readily-apparent cause for this population decline. However, it is possible that the relative stagnation of Delaware City's economy during the 1960's could have been a factor in the net population loss of the 1970's. Unfortunately, this is a hypothesis which cannot be tested until more specific data on in-migration and out-migration is available for Delaware City from the 1980 Census.

7. The supply of housing in Delaware City has increased significantly during the past several decades, despite the dramatic fluctuations in the population. During the 1950's, 89 new units were constructed, representing slightly more than 17 percent of the 1960 housing stock. During the 1960's, 79 new units were built, representing approximately 14 percent of the 1970 housing stock, while population increased by 22 percent during each of these two decades. The net housing supply (new plus existing units, less demolished units) has also increased, by 12 percent during the 1960's and by 19 percent during the 1970's. The sizeable increase in the net housing supply between 1970 and 1980 is particularly interesting when juxtaposed against the population decline of 8 percent.

Based on the above trend analysis, it is concluded that the population of Delaware City has stagnated or even undergone a modest decline relative to several key social and economic indicators, including family income, education, and employment. After sustaining two decades of population increase during the 1950's and 1960's, the community sustained a net population loss during the 1970's. The only area of real growth which has consistently occurred since 1950 is the total housing supply. While these indicators do not exhaustively describe the changes that have taken place in the town over the recent decades, they are noteworthy nonetheless.

COMPARATIVE SOCIO-ECONOMIC CHARACTERSTICS

Another useful method of depicting the social and economic make-up of a community or area is to compare it at one point in time with other nearby communities

or areas, relative to a group of key socio-economic characteristics. When Delaware City is compared with its surrounding and nearby geographical areas, it compares rather poorly on a number of dimensions. The comparison, shown in Table 22, utilizes census tract data from the 1970 Census, the most recent data which was available. The census tracts with which the town was compared include:

— Central Pencader Hundred (tract 148.02);

—New Castle Hundred, below New Castle (tract 163);

—Red Lion Hundred, excluding Delaware City (tract 164);

—Appoquinimink Hundred, excluding Middletown (tract 166);

—Town of Middletown (tract 167).

Data from New Castle County has also been included for comparative purposes.

As can be seen from Table 22, Delaware City in 1970 exhibited the lowest median family income, the lowest median school years completed, the smallest percentage of high school graduates, the smallest percentage of "white collar" workers, and the smallest percentage of self-employed workers, when compared with its neighboring geographic areas. All of these areas are outside of the heavily-urbanized portion of New Castle County. Delaware City had the highest proportion of elderly people, and the second highest proportion of racial minorities. The town reflected more positive conditions on two key dimensions: percentage of families below the povery level, and the unemployment rate of the work force.

Based upon these findings, it is reasonable to conclude that while the community has not been plagued by excessive poverty and unemployment, it is a relatively depressed area, with predominantly moderate-to-lower-middle-income families employed primarily in the trades and services. All of the census tract areas with which Delaware City was compared were found to be below the income and educational levels of New Castle County as a whole, and Delaware City was even below the levels for these other areas.

TABLE 22

COMPARATIVE SOCIO-ECONOMIC CHARACTERISTICS, 1970 CENSUS
DELAWARE CITY AND SURROUNDING AREAS

Characteristics	Delaware City Tract 165	Red Lion Division Tract 164	New Castle Division Tract 163	Central Pencader Division Tract 148.02	Middletown-Odessa North Division Tract 166	Middletown Tract 167	New Castle County
	AREAS AND CENSUS TRACTS						
AGE DISTRIBUTION							
• % age 65 and over	12.5	9.2	4.9	5.7	10.7	10.9	7.5
RACIAL COMPOSITION							
• % Negro	17.6	6.7	1.6	4.4	12.7	29.7	12.7
FAMILY INCOME							
• Median, yearly	$8,181	$10,250	$10,690	$10,280	$9,083	$9,389	$10,985
• % of families below poverty	6.9	9.4	10.0	5.3	10.4	16.4	6.6
EDUCATION							
• Median school years completed	10.1	11.0	11.9	11.7	10.4	11.0	12.2
• % high school graduates	29.1	43.0	49.0	47.4	36.5	39.8	57.6
EMPLOYMENT							
• Unemployment rate	4.8	7.9	1.7	2.5	10.7	0.0	3.1
• % white collar workers[1]	28.1	44.7	56.8	34.0	35.5	38.0	55.3
• % self-employed	5.0	5.5	7.1	9.8	11.0	7.5	4.3

Notes: [1] Includes the occupational categories:
(1) professional, technical, and kindred workers;
(2) nonfarm managers and administrators;
(3) sales workers; and
(4) clerical and kindred workers.

Source: 1970 Census of Population and Housing

ECONOMIC IMPACTS ATTRIBUTABLE TO THE REFINERY

Employment Impacts

The most direct economic impact of an industrial facility upon an adjacent community relates to the number of employment opportunities made available to members of the community. Because of the emphasis on the employment of trained, experienced workers and/or unionized workers, there were very few jobs for Delaware City residents during the construction of the refinery and its early operating years. Since the inception of the refinery, other industrial firms have chosen to locate nearby, to have direct access to the refinery's products or consumption needs. These companies have swelled the work force at the industrial complex to approximately 2,000 workers. However, the number of Delaware City residents employed at the complex as a whole has remained fairly low. In 1968, 21 Getty employees and a total of 64 employees of the entire petrochemical complex were Delaware City residents.[2] Currently, according to figures provided by Getty and other sources, these numbers have increased to 40 and 120, respectively. The current level of total refinery employment is between 900 and 1,000. Therefore, the employment of Delaware City residents represents less than 5 percent of the refinery work force, and approximately 6 percent of the industrial complex as a whole.

Based upon these estimated employment levels, it is clear that Delaware City residents are not numerically prominent within the work force of the refinery or the petrochemical complex as a whole. Moreover, it is evident that neither the refinery nor the remainder of the petrochemical complex are a dominant source of employment for the town's residents. Using data provided by the 1970 Census (the most recent available information), it has been determined that of the total 1970 work force in Delaware City of 677 people, resident employment at Getty (21 people in 1968) represented approximately 3 percent of the town's work force. Resident employment at the entire petrochemical complex (64 people in 1968) represented under 10 percent of the town's work force. In 1969, these employment opportunities yielded annual earnings amounting to 3 percent and 8 percent, respectively, of the town work force's total earnings. It is entirely possible that these proportions have increased in recent years, based on the higher employment numbers of resident-employees. However, data on the current size of the town's work force was not available to make the comparison.

The employment issue can be further understood from another perspective. When the 1970 proportion of Delaware City's work force engaged in the nondurable manufacturing and construction industries was compared to the surrounding geographical areas, it revealed that Delaware City had the smallest proportion of workers in these two industries in 1970, as shown in Table 23. These two industries are the most directly related to the jobs at the petrochemical complex.

When the three employent perspectives discussed above are pieced together, it appears that employment at both Getty and the petrochemical complex as a whole is not a major source of employment for Delaware City residents. Furthermore, it is probable that a greater share of the refinery's employees reside in areas adjacent or close to the town, than within the town itself.

TABLE 23

EMPLOYMENT IN THE NONDURABLE MANUFACTURING AND CONSTRUCTION INDUSTRIES, 1970
DELAWARE CITY COMPARED WITH SURROUNDING AREAS

Industry	AREAS AND CENSUS TRACTS					
	Delaware City Tract 165	Red Lion Division Tract 164	New Castle Division Tract 163	Central Pencader Division Tract 148.02	Middletown-Odessa North Division Tract 166	Middletown Tract 167
MANUFACTURING - NONDURABLE GOODS: Percent of Work Force	11.2	20.8	18.4	18.6	15.7	19.6
CONSTRUCTION: Percent of Work Force	8.7	12.9	8.2	18.3	15.9	10.3
BOTH INDUSTRIES COMBINED: Percent of Work Force	19.9	33.7	26.6	36.9	31.6	29.9

Source: 1970 Census of Population and Housing.

Retail Trade Impacts

The Delaware City commercial business environment can best be described as sluggish, it not weak. Despite the presence of a relatively stable population, an active summer tourist flow, and several large industrial facilities on the periphery of the town, (including the Getty refinery), the commercial sector has shown little or no growth through the years and, in fact, has been declining in recent years to its present condition of under-utilization. Table 24 displays the results of field surveys of the Delaware City commercial district completed in 1969 and 1982.

TABLE 24

NUMBER OF RETAIL STORES,

DELAWARE CITY, JANUARY 1969 AND AUGUST 1982

Type of Business	Number Jan. 1969	Number Aug. 1982
Food Stores	1	3
Eating and Drinking	10	6
Gasoline Stations	5	2
Drug Stores	1	1
General Merchandise	1	1
Specialized Merchandise	0	2
Apparel	1	1
Furniture and Appliance	2	2
Lumber, Building, and Hardware	1	1
Automotive	0	0
TOTAL	22	19

Sources: New Castle Department of Planning Survey, January 1969
William J. Cohen and Associates Survey, August 1982.

The decline in the number of retail establishments during this period is more striking upon visual inspection of the Delaware City central business district. Specifically, the business district includes a number of currently vacant buildings and store fronts which may have been, and could still become, commercial establishments. The August, 1982 field survey found 15 such vacant storefronts. Several of those were either in the process of being renovated or were targeted for future renovation. Most of

these properties appeared to be in sound condition. A Wilmington businessman with interests in Delaware City was renovating one structure, with the plan of adapting it to new commercial and residential uses. However, an area realtor claimed that it was virtually impossible, at this time, to interest an investor in commercial property in Delaware City.[3] Thus, it can be assumed that Delaware City's commercial sector will continue for some time to be dominated by small convenience stores to meet the needs of the local populace, and some tourist-oriented retail stores such as restaurants and gift shops. However, it is commonly perceived that retail establishments in the town have not enjoyed the trade advantages associated with tourism that might be potentially attainable.

An important aspect of Getty's economic impact upon Delaware City is the amount of local retail revenue attributable to income earned by town residents employed at the refinery and adjacent industrial facilities. These adjacent companies were included in the economic analysis because their location at Delaware City is owed to the existence of the refinery.[4] Clearly, the impact of the industrial complex upon the retail sector goes beyond the resident-employee expenditures. Many non-resident employees of these firms patronize Delaware City's retail establishments, especially the taverns and restaurants and, to a lesser extent, the drug store, clothing store, and hardware store. In addition, the refinery, as a business firm, conducts business with several Delaware City establishments, including Seaways, which provides docking and spill clean-up services, and Kirk's Hardware store. However, attempts to quantify these activities proved unsuccessful. Therefore, the existence of the impact of these activities having been acknowledged, the analysis will focus upon the former impact, that is, resident-employee expenditures.

Because of the limited availablility of current, reliable data on employee earnings, consumer expenditures, and retail sales volumes in Delaware City, the impact calculations necessitated several assumptions, estimates, and average values. Also, data from different years had to be used in some cases. It was decided that the retail analysis should focus on a group of selected retail establishments which: 1) constitute the major retail activities in town; and 2) for which the best data is available. The establishments which met both of the above criteria include:

—two grocery stores
—two gasoline stations
—two eating and drinking establishments
—two eating establishments (eating only)
—one drinking establishment (drinking only)

The primary sources of data were the U. S. Census of Retail Trade (1977), the Delaware Department of Labor's Monthly Earnings Reports, and a merchant survey conducted by the Consultant in Delaware City in May, 1982.

According to figures provided by the Getty Refining and Marketing Company and other sources, approximately 120 Delaware City residents are currently employed at the industrial complex, of which approximately 40 are employed directly by Getty. These numbers represent a significant increase since 1968, when the figures were 64 and 21, respectively. Based upon the reported average weekly earnings for workers in chemical and allied products in the Wilmington Metropolitan Area from December 1980 to March 1982, these 120 current employees would be expected to earn approximately $2,373,800 in total annual income. It was then estimated, based upon two separate measures of consumer spending patterns, that of this total income, approximately $560,000 would be spent per year on the types of consumer goods available at the selected group of retail establishments. Naturally, not all of this $560,000 would be spent in the Delaware City

stores. However, since it was impossible to estimate the percent actually spent in Delaware City, as opposed to elsewhere, the $560,000 amount was used. Because of this decision, it must be recognized that all subsequent computations may be somewhat optimistic.

The total expected annual sales volume of the selected group of retail establishments was estimated in three ways. First, data on sales volumes obtained from the merchant survey conducted by the Consultant was employed. The other two methods involved using the Census of Retail Trade to determine total expected annual consumer expenditures for these selected categories of retail goods, and determining total expected annual sales volumes for these types of retail stores. By averaging the outcome of the three calculations, a total expected annual sales volume for the selected group of establishments of $3.3 million was estimated.

It was then determined that the $560,000 of estimated retail expenditures by Delaware City residents employed at the industrial complex amounts to approximately 16 percent of the total estimated annual sales volume of these key selected retail establishments. These dollars, which are transferred from Getty and the other industrial companies to their employees and, subsequently, to Delaware City stores, thereby create a "multiplier effect." This effect continues further, because these merchants reinvest that money by paying themselves and their employees, who, in turn, patronize other Delaware City stores, and so forth. In effect, then, by hiring Delaware City residents, these companies are investing in the economic security of the community. While an economic impact on the order of 16 percent represents an enormous dollar impact in a big or medium-size city, in a community the size of Delaware City one might have expected an even larger impact, considering the wages that these workers are paid (in excess of the average local income) and considering that the companies at the industrial complex offer so many potential job opportunities (in total). It is especially interesting to note that Getty itself only contributes about one-third of the total income effect (about five percent). While it is said that the Getty refinery has been directly responsible for the generation of several new businesses in the area, including one specifically located and based in Delaware City (Seaways), the overall dollar volume generated by this business is not sufficient to appreciably alter the magnitude of trade stimulated by the refinery. It can therefore be concluded that while Getty and the related companies contribute a fairly substantial dollar amount to the Delaware City economy, they cannot be considered dominant economic forces within the community.

Impact of Real Estate Values

Another important aspect of the economic effect of an industrial facility upon an adjacent community is the effect on the housing market and on real property values. Despite the significance of this issue, the following analysis cannot be considered definitive for several reasons. First, there are no communities in the area with which Delaware City is perfectly comparable, relative to real estate. Secondly, the housing market and property value conditions are not solely attributable to any one factor, for example, the Getty refinery. Thirdly, it is not possible, based on readily available information, to determine whether conditions changed appreciably during the first several years the refinery came into being.

However, it can safely be assumed that the proximity of a major oil refinery and related petrochemical complex to the town contribute to the condition of the housing market and property value climate in Delaware City, and the conditions do not appear favorable. Two real estate agents were contacted who are knowledgeable about real estate trends in Delaware City relative to other places. They have indicated that Delaware City's real estate market is in a depressed state, even after allowing for the

overall economic conditions which have recently plagued the real estate and housing industries nationally. While it is probably the case that these depressed conditions have existed for many decades, perhaps coinciding with the town's overall economic decline and importance as a transportation and fishing center, other factors would be expected to have triggered a resurrection of the real estate market in more recent years. Principal among these factors is the increasing recognition of the value of older, historically significant places, which has figured prominently in the popularization of New Castle and Odessa. This trend has not benefitted Delaware City to nearly the same extent, even though the town's historical significance is widely acknowledged. Owner units and rental units do not command anywhere near the price in Delaware City that they command elsewhere, including historically significant residential and commercial properties. One realtor stated that Delaware City has a housing market which is primarily attractive to first-time buyers, since prices are substantially lower than for comparable homes elsewhere. Both realtors independently estimated that in Delaware City real estate may command, on the average, 70 percent of the value that a similar property could command elsewhere.

This assessment is confirmed by an examination of the 1970 median value of owner residential units.[6] When Delaware City's median value is compared with that for Middletown, a town of reasonably comparable size and comparable proportion of homes built before 1940, Delaware City's median value is precisely 70.0 percent of Middletown's. The two towns also appear to have homes of comparable size, based upon an examination of the median number of rooms per unit, median number of people per unit, and the density of people per room. Both towns also have access to public water and sewer service. If anything, Middletown's housing stock is somewhat inferior, since it had twice the proportion of units lacking some or all plumbing facilities. Also, Delaware City is located much more advantageously for access to employment and commerial centers.

It was pointed out that many potential home-buyers would not even look at a home in Delaware City. A number of possible reasons were provided for this negative image. First, the existence of boarded-up and vacant properties on Clinton Street was cited as a factor. Second, groups of loitering teenagers and youngsters are believed to detract from the town's image. Also, it was pointed out that no matter which way one enters Delaware City, unappealing features dominate the view—the Salem Nuclear Plant to the south, and the Getty refinery to the west and north. It was suggested that the refinery is one possible cause for the town's poor public image and position in the real estate market. Both realtors believed, however, that a significant upsurge in Delaware City's commercial sector could provide the impetus for a turnaround in real estate market conditions.

In conclusion, it has been determined that the housing and real estate market in Delaware City is depressed relative to surrounding areas, and it is believed that the existence of a major oil refinery and petrochemical complex is partially responsible for these conditions. While it is impossible to quantify this impact, it is important to acknowledge its existence.

CONCLUSIONS

Taking into consideration all of the factors which have been discussed in this section, the following conclusions are offered relative to Delaware City's economy and the extent to which it has been affected by the refinery.

1. Delaware City's social and economic fabric, as measured by a number of commonly-used social and economic indicators, reflects a populace with relatively less adequate resources than in the surrounding areas. This relative inadequacy is marked by such 1970 characteristics as basic educational deficiencies; a relatively high proportion of elderly residents; a relatively low proportion of "white collar" workers, craftsmen, and foremen in the town's work force; and a relatively lower annual family income. Despite these inadequacies, the community is buoyed by a reasonably healthy rate of employment and proportion of families living above the established poverty line.

2. Delaware City's economy, which was in serious trouble by 1950, was probably aided by the coming of the Getty refinery and the subsequent location of a number of "satellite" petrochemical industries. The construction of these facilities stimulated the town's economy, although only temporarily. Getty and the other industries opened up some new employment opportunities for town residents, stimulated local trade, and probably contributed to an increase in population and new housing construction.

3. Overall, the refinery, even in conjunction with the "satellite" industries, does not appear to be a dominant force in the community's social and economic life. From an employment aspect, it is probable that the state-run Governor Bacon Health Center has been a more substantial source of economic stability in the town. Nevertheless, the petrochemical complex, including the refinery, has at least helped prevent the town's economy from deteriorating to the extent that it might have, had these facilities not been located nearby.

4. While estimates of the economic benefits of the tourism which Delaware City enjoys were not available, it can be presumed that there are indeed such benefits which accrue to the town's business establishments. There is reason to believe that the potential trade benefits of this tourism are not being fully realized. Furthermore, there is reason to believe that the potential for tourism itself has not been fully realized. It is not currently known what effect the refinery and petrochemical complex have relative to either the encouragement or discouragement of tourism in the town, and its related retail trade benefits.

RECOMMENDATIONS

In light of the socio-economic analysis of Delaware City as presented in this chapter, along with the conclusions which have drawn from this analysis, the following recommendations are made concerning actions which can be taken by the Mayor and Council of Delaware City in conjunction with other interested groups. These recommendations are intended to create or enhance existing economic benefits, and to create new economic opportunities.

1. It is recommended that town leaders appeal to representatives of the management of the Getty refinery, either alone or in conjunction with the other "satellite" petrochemical industries, to explore possible ways of increasing employment opportunities for qualified Delaware City residents. While it is possible that such an "affirmative" approach is already a standard practice at these installations, any progress of this nature will tend to enhance the economic well-being of town residents, and at the same time, will tend to promote harmonious relations between the company and the community.

2. It is recommended that the Mayor and Council pursue Federal or other funding for the purpose of undertaking a comprehensive commercial revitalization planning study. Such a study should be organized to:

   — Establish a baseline of detailed, up-to-date information on trade characteristics and trade volumes among the town's commercial establishments;

   — Assess the local demand for retail and wholesale goods and services which is currently not being met; and

   — Develop a strategy for encouraging the expansion of existing firms and/or the location of new firms, in order to meet whatever unsatisfied demand has been identified.

3. It is recommended that the Mayor and Council, in conjunction with any other interested parties, develop a promotional strategy or campaign to enhance tourism to the town. Such a strategy should include the identification of all features and resources which the town has, which might be of interest to tourist visitors. Such a strategy should also include the development of a broad-based publicity strategy, in order to communicate the town's attractions and points of interest.

CHAPTER NOTES

1 Bureau of the Census, United States Census of the Population, Delaware, U. S. Department of Commerce, 1960 and 1970).

2 New Castle County Department of Planning, Economic Characteristics: A Delaware City Comprehensive Development Plan Background Study (New Castle County Department of Planning, January 1969), Table 29, p. 55.

3 Interview with Mr. John Price, Patterson Schwartz Realtors, August 18, 1982.

4 Interview with Mr. Ray Arzinger, Vice President and Plant Manager, Getty Refining and Marketing Company, May 28, 1982.

5 Interviews with Mr. John Price, Patterson Schwartz Realtors, and Mr. Harry J. Nickle, Nickle Insurance and Real Estate, August 15, 1982.

6 Bureau of the Census, 1970 Census of Population and Housing, Wilmington, Delaware SMSA (U. S. Department of Commerce, 1972), Tables H-1 and H-2, pages H-8 and H-18.

CHAPTER 13

COMMUNITY SERVICE AND FISCAL IMPACTS

INTRODUCTION

The purpose of this analysis is to identify the extent to which the presence of the Getty refinery has either enhanced or inhibited the provision of community services, including the financing of these services through the fiscal budgetary process. Certain parts of this analysis will refer to the refinery property as a whole, including both the Delaware City and unincorporated New Castle County portions of the property. Other parts of the analysis will focus on only that portion of the refinery property that is within the boundaries of the city, for which the company pays City property taxes.

The analysis will proceed by first identifying and describing the community services provided by the City government and describing the fiscal process utilized by the City. Next, the interrelationship that exists between the refinery and the provision of municipal services will be examined. Third, the impact of the refinery on City fiscal operations will be discussed. The most important findings of these examinations will be presented as conclusions, followed by recommendations to reduce adverse impacts, or to enhance beneficial impacts.

MUNICIPAL SERVICES AND FINANCES

Residents of Delaware City receive a variety of public services, including: public education; library services; health services; postal services; police protection; fire protection; domestic and other public water services; gas service; electric service; sanitary sewer (waste water) service; parks and recreation; building and zoning code administration; sanitation; street maintenance; and other miscellaneous services. Of these services, only a portion are provided directly by the City government, including: water service; zoning code administration; sanitation; street maintenance; and health code administration. The remaining services are supplied by other governmental jurisdictions, special-purpose districts, or private utilities. However, in several of these cases where the City government is not the direct provider of the service, financial payments and in-kind contributions are made, as is the case with the town library, police protection, fire protection, health care, and parks and recreation. Police protection had been provided directly by the City government until 1980, but is now purchased from the State Police.

The costs of operating the City government in fiscal year 1981 amounted to slightly more than $443,400.[1] These costs reflect the costs of directly-provided services, payments and contributions toward the provision of other services, and administrative costs. The approximate breakdown by cost area was as follows:

Administrative and General	$150,259
Street Maintenance	85,711
Water Service	64,566
Sanitation	56,750
Police	86,163
Total	$443,449

The "Administrative and General" category included approximately $2,500 for the

Delaware City Volunteer Fire company, $4,600 for recreation, and $1,056 for the Visiting Nurses Association, which operates a health clinic at Town Hall.

The revenues necessary to meet these costs came from a number of sources, including:

- Municipal property and capitation taxes;
- Real estate transfer tax;
- Revenue Sharing (Federal Government);
- Municipal Street Aid (State Government);
- Water service fees;
- Other Federal, State, and County grants;
- Refuse collection fees;
- Fines; and
- Miscellaneous sources.

In fiscal year 1981 these sources produced just over $385,000 in revenue, approximately $165,000 of which came from property taxes, representing 43 percent of total revenue.

The property tax, as a source of revenue to finance City government operations, has fluctuated over the years in terms of its relative importance. As indicated in Table 25, it was at its highest during the period 1956-1959, when it represented between 55 and 66 percent of all revenues.[2] It then decreased significantly during the years 1960-1968, as a result of several factors, including:

1. A decrease in the property tax rate, from 0.0085 to 0.0080, effectuated because of the creation of a separate authority for parks and recreational programs;
2. The city's purchase and take-over of the water system, which began yielding water service user fees;
3. The growing impact, during part of this period, of taxation policies which imposed constraints on property tax revenues, particularly as applied to Tidewater (Getty) property;
4. The increased use of loans as a source of revenue, necessitated by insufficient tax revenues in the face of increased expenditures, particularly between 1963 and 1965; and
5. A large increase in revenues from the Muncipal Street Aid Fund starting in 1966.

During the 1970's a County-wide reassessment provided the City with the basis for boosting property tax revenues. In addition, the property tax rate was increased four times, from its 1969-1971 level of $1.20 per $100 of assessed value to its current level of $1.85, which has been in effect since 1979. Nevertheless, the importance of the tax as a

TABLE 25

CITY OF DELAWARE CITY
MAJOR SOURCES OF REVENUE
AS A PERCENTAGE OF TOTAL REVENUES

1956-1981

Year	Property Taxes[1]	Federal, State, and County Grants	User Fees
1956	71.0%	0.0%	0.0%
1957	78.0	0.0	0.0
1958	60.8	31.7	0.0
1959	62.0	29.0	0.0
1960	43.2	20.3	3.3
1961	39.9	20.6	26.8
1962	11.7	6.8	7.9
1963	38.5	21.0	22.7
1964	33.4	18.9	26.5
1965	29.5	16.4	23.9
1966	37.4	23.9	22.3
1967	40.0	23.2	18.3
1968	41.1	25.4	25.9
1969	45.3	19.6	21.9
1970	37.8	21.9	14.1
1971	42.0	24.1	16.0
1972	38.2	15.5	12.4
1973	30.1	32.3	8.8
1974	43.6	29.0	9.2
1975	40.3	37.2	11.6
1976	38.9	42.4	10.4
1977	25.4	62.0	7.1
1978	18.2	71.9	6.2
1979	23.9	64.3	6.5
1980[2]	46.8	24.6	20.3
1981	42.8	31.0	20.2

Notes: [1] Includes capitation tax revenues which constitute only a small fraction of total tax revenues (excludes real estate transfer taxes).

[2] Estimates, based on budgeted revenues.

Sources: New Castle County Department of Planning
City of Delaware City Financial Statements, 1969-81

proportion of total revenues has remained relatively constant during the decade, balanced by an increased reliance on Federal, State, and County grants.

MUNICIPAL SERVICES TO GETTY

Since the early 1970's, Getty has not received any direct municipal services from Delaware City, with the exception of the regulation of Getty's land uses within the City limits, accomplished by the City as part of its police powers. The refinery is virtually self-sufficient with respect to water, waste water, solid waste, street maintenance, and security. At one time, the City did provide mowing and sweeping services to the refinery, for which it received a fee over and above the company's property tax payments. For the year 1969, this fee brought over $6,000 into the City's coffers.[3] However, the arrangement was discontinued after it was determined that the City was unable to allocate adequate resources to the provision of this service. In more recent years, Getty has retained the services of a private entrepreneur from the nearby area to provide mowing and landscaping services.

For a period of years during the late 1970's, Getty purchased a small portion of its water from the Delaware City Volunteer Fire Company, for which the company paid approximately $20,000 per year. The arrangement evolved in 1976 after a pipeline broke which carried water from the main refinery area to the marine terminal, to supply tankers. After several years, the Mayor and Council expressed an interest in having the City government sell the water directly to Getty, in an effort to enjoy the additional revenues that the arrangement could produce, while continuing to provide a benefit to the fire company. However, negotiations between the City and the refinery to arrive at an agreeable price, broke off when the Mayor and Council held to an offer which the refinery's management found to be totally unacceptable. As a result, the refinery water line was repaired instead and both the city and the fire company lost the opportunity to have this additional revenue.

MUNICIPAL SERVICES AFFECTED BY GETTY

Although Getty has not received any significant services from the City government throughout the years, the refinery has affected several aspects of the provision of services to the community.

Clearly, one major way that the refinery has had a positive impact on the provision of municipal services is through its property tax payments, which have represented a significant source of financial support for municipal operations. The precise extent of this support is discussed more fully in the next section. However, this positive impact has been diminished by two factors which have adversely affected the City's finances. One factor pertains to the additional electric utility costs sustained by the City's groundwater withdrawal operations, resulting from Getty's own groundwater withdrawal. This affect, which was discussed in Chapter 6, involves the additional pumping effort required at the City's water wells to bring groundwater to the surface, necessitated by the drawdown in the aquifer water level attributable to the refinery's pumpage from the same aquifer. It was estimated that this drawdown has amounted to 40 feet or more in vertical distance at Delaware City's wells. Therefore, the City's pumps must pump the water an additional 40 feet or more to reach the surface. It would be extremely difficult to calculate how much of the $17,000 in 1981 utility costs for the municipal water system can be attributed to this situation. Moreover, even if the amount was identified, Getty's liability relative to this impact must be balanced against the fact that the refinery's pumpage from this aquifer commenced at least five years

before the City began using the aquifer. By that time, the affects of Getty's pumpage had already occurred and therefore constituted a pre-existing condition relative to the City's pumpage. The other Getty-related factor which has had a potentially adverse affect on the City's finances pertains to the general level of real estate values in the community. As discussed in Chapter 12, Socio-Economic Impacts, real estate values in Delaware City have been determined to be depressed relative to values throughout the surrounding area. Several real estate experts, contacted during the conduct of this study, have estimated Delaware City's real estate to be valued at approximately 70 percent of the prevailing market values in the area. It has been indicated that the proximity of the refinery to the town has been a devaluing factor, along with several other factors. The precise affect of the refinery itself on town real estate values is not knowable. However, to the extent the refinery contributes to the devaluation of Delaware City property values, it affects the city government's revenues, since the property tax used by the municipality as a major source of revenue is based on assessed valuation. This reduction in the assessed valuation of taxable properties in Delaware City (excluding Getty's property) may have resulted in the loss of an estimated $16,000-$17,000 in tax revenues per year in recent years.

Another area in which Getty has affected the provision of municipal services pertains to recreational opportunities, as discussed in Chapter 14. The presence of the refinery has created both positive and negative impacts on the availability of recreation in the town. The negative impact occurred as a result of the development of Baby Beach as the site for the refinery's marine terminal. Until the refinery had purchased and developed this area, the beach had been a popular bathing location for town residents, because of its wide, flat stretch of fine sand. The construction of the marine terminal consumed most of the beach area, although a portion of it remained accessible and the company permitted its continued use for bathing. An additional area along the waterfront at Battery Park was available for use by bathers as well. However, the construction of a badly-needed sea wall at Battery Park by the State of Delaware in 1978 displaced this portion of beach area. It is clear that the refinery cannot be blamed entirely for the loss of bathing opportunities, since the State's construction of the sea wall also had a significant impact. Moreover, the "swimmability" of the Delaware River at Delaware City has been largely hampered by pollution of the river since long before the refinery was constructed. An important positive impact created by Getty relative to recreation was the donation to the City of approximately 5.7 acres of refinery property, located within the City limits along Route 9. This land donation has benefitted the town in several ways, primarily by expanding recreational opportunities and by serving as a source of matching for Federal and other grant funds.

A third way in which Getty has affected the provision of community services pertains to the contribution of a tanker truck to the Delaware City Volunteer Fire Company. Although this contribution does not directly affect City government-provided services, it has had the affect of helping to equip the fire company without the necessity of monetary contributions from the City government and area residents.

Finally, the company has made various other contributions over the years which have assisted the City in providing services to the community. For instance, during the late 1950's the company loaned various types of heavy equipment to the City which enabled the City to avoid having to purchase them. A building was donated for use as a community center, although it was subsequently sold. The value of Getty's industrial lands within the City limits was a major factor in the City's ability to secure bond revenues in 1961 at 3 1/2 percent interest, to accomplish the acquisition and improvement of the municipal water system.[4] More recently, the company donated 90 tons of quarry waste to the City to assist in the repair of streets.[5]

GETTY TAX PAYMENTS TO THE CITY

A portion of the Getty refinery's land holdings, amounting to approximately 400 acres, has been located within the City limits since the company initially acquired their land in 1954-55. The company has therefore been subject to the City's property tax since that time. Over the years, the company's property tax payments have been an important source of revenue to the City, amounting to more than 10 percent of the City's total revenue for all but six of the past 28 years. In fact, as shown in Table 26, Getty's property tax payments have represented more than 15 percent of total revenues for ten of these years and more than 20 percent for nine years.

TABLE 26

GETTY PROPERTY TAX PAYMENTS TO DELAWARE CITY, 1956-1980

Year	Getty Tax Payments	Total City Revenue	Getty Tax As A Percent of Total Revenue
1956	$ 901	$ 15,764	5.7
1957	9,500	18,306	51.9
1958	10,000	42,746	23.4
1959	10,000	45,953	21.8
1960	10,000	71,430	14.0
1961	10,000	73,016	13.7
1962	10,000	220,692[1]	4.5
1963	10,000	73,210	13.7
1964	10,000	78,882	12.7
1965	10,000	89,778	11.1
1966	20,548	101,803	20.2
1967	20,456	101,723	20.1
1968	20,456	91,782	22.3
1969	30,684	119,296	25.7
1970	30,684	147,139	20.9
1971	30,684	131,951	23.3
1972	33,241	167,690	19.8
1973	38,152	265,884	14.3
1974	35,860	239,984	14.9
1975	35,904	268,566	13.4
1976	35,904	295,886	12.1
1977	45,896	485,956[2]	9.4
1978	53,545	817,295[3]	6.6
1979	59,098	604,023[3]	9.8
1980	62,106	(not available)	—

Notes:
[1] Includes $150,000 in bond issues.
[2] Includes extraordinarily large Federal, State, and County grants totalling $200,000.
[3] Includes receipt of Federal Economic Development Administration "Public Works" grants, totalling $461,554 in 1978 and $226,272 in 1979.

Sources: Getty Refining and Marketing Company
New Castle County Department of Planning
City of Delaware City Financial Statements, 1969-81.

The significance of Getty's tax payments would have been even greater, had it not been for the 1954 Mayor and Council resolution, unanimously passed, which extended ten years of tax abatements to the refinery. These tax remissions applicable to the amount in excess of $10,000 for each of the ten years, cost the City an estimated $90,000 in foregone revenues. During the years that the tax remission was in effect, the City was forced to borrow almost $54,000 to meet its financial needs. As discussed in an earlier chapter, it appears that this remission, and the resultant financial troubles and ill-will that stemmed from it, were probably not even necessary to bring the refinery to Delaware City. It was not mentioned by company officials as a factor in their selection of the Delaware City site for the refinery.[6]

In 1971, the Mayor and Council of Delaware City approached refinery officials to consider annexing the balance of the refinery property, amounting to approximately 3,000 acres, to the City. This property came under the exclusive taxing jurisdiction of New Castle County. Refinery officials declined to initiate the effort, indicating a reluctance to jeopardize their positive relations with the County, as well as their concern about the treatment they would receive from the City in the future years if they were to annex this land. Had this land been annexed, the benefits to the City would have been staggering: total assessed valuation would have increased three and one-half times, and the additional 1971 tax revenues would have amounted to approximately $200,000, one and one-half times the amount of total 1971 revenues.[7]

Also in 1971, a County-wide reassessment of all property values was undertaken, in an effort to more realistically reflect the value of the tax base from which the County and its incorporated municipal jurisdictions, including Delaware City, derived their property tax revenues. Evidently, the Mayor and Council of Delaware City were not satisfied that the assessors had adequately established the market value of Getty's holdings within the City. Accordingly, the assessed value of these properties was subsequently increased, producing a larger tax payment from the refinery. The refinery's management did not detect the change until sometime in 1979, according to available records. In 1980, the County was brought into the dispute and determined that the assessed value of Getty's property was too low from their perspective as well. A County effort to reassess this property was subsequently challenged by Getty, and the whole matter has been referred to litigation. Delaware City has agreed to abide by the decision, and meanwhile, has placed the refinery's excess tax payments in escrow, pending the resolution of the dispute.

This situation underlines Getty's philosophy, stated by the refinery management, that they will not hesitate to pay taxes which they feel have been applied "fairly." When they feel that they are not being taxed fairly, the record of past situations reveals their willingness to fight the levy through litigation, political pressure, and other means. In one instance, company executives even threatened to terminate their operations at Delaware City altogether. The matter involved a bill passed by the Delaware General Assembly which provided for a tax on each gallon of crude oil processed by the refinery. After the company registered their threats to close down, Governor Tribbitt vetoed the legislation, even though he had initially encouraged its passage.[8]

CONCLUSIONS

The Getty refinery has affected the provision of community services and municipal finances in a number of ways over the years since it commenced operating in 1956-57. Some of these impacts have been positive and have helped to enhance life in the community, while others have been negative and have tended to diminish the quality of life and/or municipal service delivery. On balance, to the extent these positive and

negative impacts can be identified and compared, it appears that the overall affect of the refinery on the community, relative to services and finances, has been more positive than negative.

Specific positive impacts which have been discussed in this chapter include the following:

1. Tax revenues to the City resulting from property tax payments for the portion of the refinery property which lies within the City limits, for which Getty receives no substantial municipal services;

2. Other revenues to the City resulting from special services which the refinery purchased, including mowing and sweeping services purchased from the City government (until the early 1970's) and water purchased from the fire company (1976-81);

3. Contributions, loans, and corporate gifts made by the refinery, including equipment loans to the City government, contributions of land, buildings, and supplies to the City government, gifts to the fire company, and contributions to the Delaware City Health Clinic; and

4. The substantial effect of Getty's property within the City limits on the City's total assessed valuation, which has been influential in enhancing the City's bond rating and increasing the City's debt limit.

Specific negative impacts which have tended to offset the value of the positive impacts include:

1. The effect of Getty's groundwater pumpage on the water level of the aquifer at Delaware City, from which the City withdraws groundwater for the municipal water system, which has resulted in higher pumping costs to the City;

2. The effect of the refinery's proximity to the town, relative to area property values, which may have contributed to the estimated 30 percent under-valuation of these properties, which affects the City's tax base; and

3. The loss of certain community recreational opportunities resulting from Getty's purchase and development of Baby Beach for use as a marine terminal.

One of the major fiscal problems encountered by the City which involved Getty, pertains to the estimated loss of $90,000 in refinery tax payments between 1958 and 1965. During this period, a municipal tax abatement policy limited the refinery's property tax liability to $10,000 per year, even though the actual tax levy on refinery lands was more than twice that amount. This is a matter for which the 1954 Mayor and Council must be given full responsibility. It cannot be known whether the legislative body was "pressured into" adopting this policy, but there is no evidence to support the assertion that the refinery's location at Delaware City hinged on it. The consequences of this action have had a far-reaching effect on the City's fiscal health, and have also left some scars on the relationship between the refinery and the community, as discussed in previous chapters.

To conclude, the Getty refinery has represented a substantial asset to the community from a community service and fiscal perspective. The more than $700,000 in tax payments made to the City between 1956 and 1981 far exceed the foregone revenues and increased direct costs which may have been caused by the refinery. In return for these payments, the refinery has not asked for, nor received, any significant municipal services. Moreover, the refinery has benefitted the community by making various loans, contributions, and gifts over the years, all of which have helped to enhance the quality or availability of community services.

RECOMMENDATIONS

In order to enhance the positive effects which the refinery's presence has had on the provision and financing of community services, it is recommended that the Mayor and Council of Delaware City seek additional support from the refinery management through non-tax-related mechanisms. The refinery's parent corporation, the Getty Oil Company, made more than $4.8 million in corporate gifts nationwide during a recent year.[9] The company has a corporate giving policy which targets money to ". . . communities where the company conducts its business." These funds are available for educational, health, and cultural purposes.

Company officials have clearly stated that they do not believe in making contributions to support on-going municipal operations, because it is felt that these operations should be supported through established fiscal procedures. However, they are receptive to making contributions for other purposes, in accordance with their corporate contributions philosophy.

The community could benefit greatly from this source of support. It is evident that, for a variety of reasons, the town has not historically realized maximum benefits from this opportunity. An effort to realize greater benefits from Getty's philanthropy is particularly crucial at this point in time, as a result of increasing budgetary limitations and in the face of reduced Federal, State, and County sources of financial support.

Therefore, the Mayor and Council should begin an effort of formulating proposed projects needed in the community which focus on the areas of education, health, and culture. These proposals should be developed carefully and thoroughly, following established procedures for proposal-writing. During their development, the advice and guidance of the local refinery's management should be sought and followed. The potential results of this cooperatively-executed procedure are significant and may be able to bring valuable services and facilities to the community.

CHAPTER NOTES

1 City of Delaware City Financial Statements, June 30, 1981.

2 New Castle County Department of Planning, Governmental Operation and Finance: A Background Study for Delaware City (January 1969), pp.8-14.

3 City of Delaware City Financial Statements, March 31, 1969.

4 Letter from Mayor William J. Smith to Mr. George Caine, Refinery Manager, May 23, 1961.

5 Sandy Dennison, "Delaware City Scrimps Its Way to Fiscal Health," Morning News (July 15, 1982) Compass p. 10.

6 News Journal Papers, May 25, 1957.

7 Estimate based on data furnished by the Getty Refining and Marketing Company, New Castle County Department of Finance and other sources.

8 David Morell and Grace Singer, Energy Facility Siting and Legislative Action, p. 167.

9 Getty Oil Company, 1981 Annual Report to the Stockholders.

CHAPTER 14

IMPACT ON RECREATIONAL AND CULTURAL OPPORTUNITIES

INTRODUCTION

The ability of people in a community to have access to meaningful recreational and cultural opportunities is considered to be an essential element of the quality of life within the community. To the extent that such opportunities do not exist, or have been impinged upon by other activities, it can be maintained that the quality of life has been accordingly diminished.

In this chapter, the significant recreational and cultural opportunities available in Delaware City are identified, including those opportunities which existed at one time, but have since disappeared. Next, the impacts of the operation of the Getty refinery at Delaware City upon various factors which, in turn, have had adverse impacts upon recreational and cultural opportunities, will be discussed. Opportunities which have been enhanced by the presence of the refinery will also be identified. Conclusions will then be drawn relative to the company's overall effect on these opportunities, and appropriate recommendations will be presented.

IDENTIFICATION OF DELAWARE CITY'S RECREATIONAL AND CULTURAL OPPORTUNITIES

For the purposes of the analysis presented in this chapter, recreational and cultural opportunities are defined to include any leisure opportunity available to all or most members of the community, which may contribute to the mental and physical health of the community and to its economic and social well-being.[1] Generally, such opportunities offer three levels of benefits: (1) immediate enjoyment; (2) long-term benefits to the individual; and (3) benefits to the community as a whole.[2]

Delaware City's resources which have been identified as providing the above-stated kinds of benefits are presented below under the categories park and recreation facilities and services; open space; water-based recreational opportunities; and historical and architectural sites.

Park and Recreation Facilities

Park and recreation facilities in Delaware City are administered jointly by the Delaware City Board of Park Commissioners and the Mayor and Council of Delaware City. Certain additional facilities are available through the Colonial Consolidated School District, which operates the Delaware City Elementary School at Fifth and Bayard Streets, and the C & D Senior Center, which operates in the elementary school building. The Fort Delaware State Park on Pea Patch Island, operated by the State Division of Parks, is directly accessible from the waterfront at Delaware City. Table 27 below lists the park and recreation facilities currently available to area residents and visitors, and identifies the recreational opportunities available at each. These facilities are also shown on Figure 22.

TABLE 27

PARK AND RECREATION FACILITIES
DELAWARE CITY

Facility	Acreage	Recreational Opportunities
1. Dragon Run Park	6.9	picnicking, playground, meeting facilities
2. Ballfield	5.7	baseball
3. 7th Street Park[1]	2.0	basketball, playground, benches
4. Battery Park	2.1	picnicking, benches, river viewing
5. Delaware City Elementary School	12.0	baseball, basketball, playground
6. C & D Senior Center	(room in the elementary school)	social services, transportation, hot meals, arts and crafts, excursions, educational presentations
7. Area adjacent to Battery Park	1.0	parking, dock facilities for visits to Fort Delaware
8. Fort Delaware State Park	160.0	picnicking, historical sightseeing

Notes: [1] This park is currently being developed by the City.

Sources: New Castle County Department of Planning
City Manager's office, Delaware City
C & D Senior Center

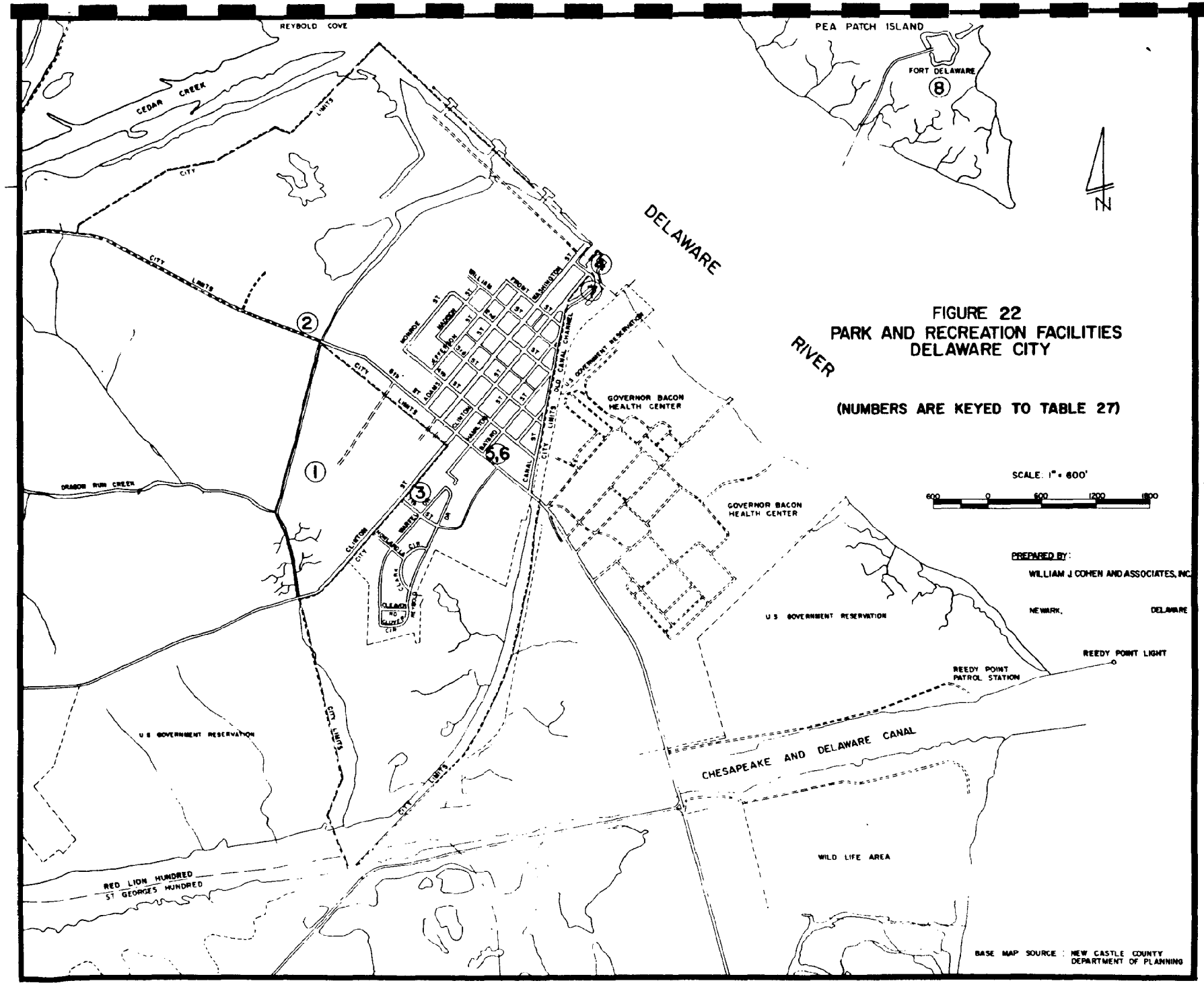


FIGURE 22
PARK AND RECREATION FACILITIES
DELAWARE CITY

(NUMBERS ARE KEYED TO TABLE 27)

Open Space

Open space, for recreational purposes, is generally defined as significant open areas of land which are undeveloped or partially developed, to which the public has access. Open space does not include parking lots, since parking lots are developed and do not generally permit recreational activities, although they may support activities occurring elsewhere.

Within and adjacent to Delaware City, there are several significant open spaces which are currently available for certain recreational purposes. The largest of these, the Chesapeake and Delaware Canal Wildlife Area, is owned by the Federal Government. Consisting of approximately 2,800 acres, it is situated south and west of the City limits, primarily along portions of the Branch Channel of the Chesapeake and Delaware Canal and along the current alignment of the canal itself. This land has been designated as a government reservation and therefore does not include any improved recreational facilities, although hiking and nature observation are permissible activities. In addition, there is a ten acre site which was donated to the City several years ago. It is located along the Branch Channel, south of Fifth Street and east of Texas Lane. The site has not been developed, but does offer public access.

A significant open space area which has disappeared within the past several decades included a large area directly north of the residential section bounded by Washington, Front, and Monroe Streets and extending eastward to the Delaware River shoreline. In addition to hiking and other opportunities, the area included a substantial stretch of fine sandy beach known as Baby Beach. It has since been taken over by the refinery operated by the Getty Oil Company and is now surrounded by high barbed wire fences.

Water-Based Recreational Opportunities

Delaware City has a valuable feature relative to recreational opportunities—its location immediately adjacent to the Delaware River and the Branch Channel of the Chesapeake and Delaware Canal (hereafter referred to as the Old Canal). As a result of this locational feature, members of the community are able to enjoy the advantage of having direct access to certain water-based recreational opportunities, particularly boating and fishing. Although there is currently no public boat launch area in the town, boats can be launched from the Delaware City Marina, which is privately operated. The marina also has the capability to dock and fuel water-borne craft. There are no developed fishing locations in the town, but there are a number of locations from which fishing can be done, both on the Delaware River and along the Old Canal. However, fishing from Delaware River waters has been greatly affected by the river's water quality for many years. As discussed in an earlier chapter, this has resulted in the disapperance of many of the fish that once flourished in the area. Although conditions have gradually improved in recent years, the river is still not considered a desirable environment for fishing.

At one time, bathing in the Delaware River was possible, with access to the water provided along Baby Beach and the edge of Battery Park. However, several factors have combined to largely preclude swimming in recent decades. For one thing, water quality in the Delaware River has been deficient since the 1930's, as a result of the dangerously-high levels of bacteria and other pollutants. Swimming has therefore been officially discouraged for many years. The swift current in the river has historically been another limitation to safe swimming. Even so, oportunities were still available for sunbathing and wading until the mid-1950's, when the development of the refinery consumed most of Baby Beach for the construction of the marine terminal. In the latter 1970's, the bathing

area at the edge of Battery Park was displaced by the State's construction of a sea wall, which was badly needed to control flooding. Essentially, all that has remained is a very small portion of Baby Beach at the foot of Washington Street, which Getty allows bathers to use. There are currently no other bathing locations at Delaware City, and the attractiveness of Baby Beach for such purposes is marginal.

Historical and Architectural Sites

Delaware City has a wealth of historical and architectural sites, in many instances dating from the earliest days of the town's history, during the first half of the Nineteenth Century. Included in this wealth are at least 20 structures located in the town, most of which still emphasize pre-1900 features. In addition, there are the remaining elements of one of the locks utilized by the original canal, the original diving bell used for maintenance of the lock's gates, and Fort Delaware, which is located on Pea Patch Island. Recently, as part of the annual Delaware City Days cultural celebration, a "Touch Museum" was created through the cooperative and creative efforts of a number of people in the community. The exhibit, currently housed in the parsonage of the Christ Episcopal Church at Third and Washington Streets, reflects a community-based effort to recreate many aspects of the town's rich history.

Two of the most historically significant structures in the area have been lost to the principles of modern industrial economics. One of these was the mansion originally built by Major Philip Reybold, called Lexington. Dating from the 1840's, the estate stayed in the Reybold family, one of the most prominent families in Delaware's history, until its sale in the 1890's to the H. P. Scott family. It was sold again in 1941 to King's College, which used it as the location for a small college campus. The house was used for administrative offices. The campus was purchased in 1954-55 by the Tidewater Associated Oil Company (Getty). The company demolished the mansion in the summer of 1955, having determined that it was of no practical use relative to the development of their giant petroleum refinery. The other structure, Marl Dale, also dated from the 1840's and was owned after 1861 by G. F. Brady, who operated the mule-powered towing of barges along the original canal. Located on unused land owned by the Getty Oil company on the south side of the Clark's Corner to Delaware City Road, the structure was demolished by the company in 1980, despite the fact that several negotiations were then underway to save it.[3] The loss of these two buildings has resulted in the loss of a part of the area's living historical and cultural heritage.

ADVERSE IMPACTS OF THE REFINERY ON RECREATIONAL AND CULTURAL OPPORTUNITIES

With the construction and operation of the refinery, the recreational and cultural opportunities available to members of the community and visitors, have been affected in several ways. Some aspects of these effects have been generally positive, while other aspects have been generally negative. These impacts are discussed below, in terms of the nature of the impacts and their effect on recreational and cultural opportunities.

Impacts Resulting from Getty Land Uses

Getty's land uses on the refinery property are primarily of a heavy industrial nature and include refinery process facilities, storage tanks, pipelines, a marine terminal, spoils disposal areas, streets, and a number of other structures and facilities to support overall refinery operations. Prior to the company's purchase and development of this land, it consisted primarily of open space, most of which was used for agriculture. A small portion of the land, along the River Road (Route 9) north of its intersection with

Wrangle Hill Road, was used as a small college campus. Along the Delaware River shoreline, north of Washington Street, lay a stretch of fine sandy beach, used by area residents for bathing.

The development of the land for its current use as a refinery has brought some pronounced changes to the land's accessibility for recreational and cultural purposes. For one thing, much of the perimeter of the refinery proper has been sealed by chain link fencing with barbed wire, an action deemed necessary for the security of the facility. Since the former Reybold estate, Lexington, was situated on land near the center of the area the company had chosen for refinery process facilities, and since the mansion itself was determined to be of no practical use, the estate was levelled during construction of the refinery. Other changes resulting from Getty land uses, discussed previously, include the elimination of public access to most of Baby Beach, and the destruction of Marl Dale which, although not an impediment to refinery uses, was destroyed nontheless. The existence of fire and safety hazards was cited by company officials as the reason for this action.

Impacts Resulting from Water Quality

As discussed in Chapter 6 and elsewhere in this report, the water quality of the Delaware River has been poor since the early part of this century. Despite significant improvements over the past decade, swimming and fishing in this water are still officially discouraged. To the extent that the refinery has discharged pollutants into the river over the years, this has contributed to the poor water quality. While the impact of pollution from the refinery has been relatively minor compared to the cumulative impact of all sources of pollution in the river, it should be pointed out that pollutants are more concentrated in water close to their point of discharge. Therefore, at locations along the Delaware City waterfront, which are relatively near the refinery's point of waste water discharge, pollution levels may tend to be higher than at locations away from the shore or further downstream.

This condition has implications for swimming and fishing along the river portion of the waterfront. While fishing does not commonly occur at this location, swimming does occur, primarily from the portion of Baby Beach between Washington Street and the marine terminal. While swimming and fishing in the segment of the Delaware River are officially discouraged by both the Delaware River Basin Commision and the Delaware Department of Natural Resources and Environmental Control, these activities are not expressly prohibited and therefore are likely to continue, unless alternative swimming locations are developed.

Impacts Resulting from Other Factors

There are several other factors associated with operations at the Getty refinery that may have indirect impacts on recreational and cultural opportunities in the town, although their direct impacts are most likely marginal. The distinction between being direct and indirect would have to do with whether these factors interfere with the actual ability to enjoy certain opportunities, or whether their effect is more one of diminishing the attractiveness of these opportunities. Such factors include the visual quality of the town as affected by the refinery, and the presence of unpleasant odors emanating from the refinery.

With respect to visual quality, it has been established in Chapter 7 that the refinery does not significantly impair visual experiences within the town, even at Battery Park, from which the marine terminal is directly visible. However, the refinery represents a major visual encroachment at one of the primary entrances to the town,

along Wrangle Hill and River Roads. This visual impact has been acknowledged as a contributing factor to the unattractiveness of the community as perceived by outsiders, along with other aspects of the refinery's operation. Therefore, it is probable that the visual aspects of the refinery detract from the community's image relative to tourist visitation. To the extent that this occurs, it implies that visitors from outside the town may not be taking maximum advantage of the recreational and cultural opportunities which are available. Since tourist visitation also provides economic benefits to the community, there are economic implications to the refinery's visual impact.

A similar phenomenon may be at work relative to the existence of unpleasant odors emanating from the refinery. While refinery odors have been widely acknowledged as a problem by residents of the town (see Chapter 5), these odors have probably not appreciably altered the activity patterns of these residents, including recreational patterns. However, the existence of unpleasant odors may be a deterrent to tourist visitation for recreational and cultural purposes, and would therefore have similar implications to those stated above relative to visual quality.

RECREATIONAL AND CULTURAL OPPORTUNITIES ENHANCED BY THE REFINERY'S EXISTENCE

The most important way that recreational and cultural opportunities have been enhanced by the refinery pertains to the City's increased ability to finance the development and maintenance of parks and other facilities, as a result of the refinery's share of City tax revenues. As discussed in Chapter 13, the company's property tax payments to the City have generally represented a significant proportion of total municipal revenues. The refinery has also been an important source of financial support for the Delaware City Community Park District and the Gunning Bedford, Jr., School District (now consolidated into the Colonial School District), both of which provide public access to recreational facilities.

In addition, the company has made several contributions to the City with the purpose of enhancing recreational and cultural opportunitites. During the late 1950's, a company-owned building on Clinton Street was donated to the Mayor and Council for use as a community center. However, the building was never improved for this use and was subsequently sold. In the late 1970's the company donated a 5.7 acre parcel to the City for the development of a baseball field. The parcel, located along the Clark's Corner to Delaware City Road on the refinery's property within the City limits, has become an important facility for area baseball teams. Moreover, the appraised value of the property has also enabled the City to obtain grant monies through the Land and Water Conservation Fund, which are being used to develop another City-owned parcel for recreational use. This second parcel, donated to the City by a private individual, is located at Seventh and Clinton Streets, in the area of Harbor Estates.

CONCLUSIONS

The presence and operation of the Getty Oil refinery at Delaware City has produced certain positive and negative impacts on the availability of recreational and cultural opportunities in the community. These impacts have implications for the ability of town residents, as well as tourist visitors, to have access to these opportunities.

The impacts which have been generally positive include the following:

1. The community's capability to finance the development and maintenance of

parks and other recreational facilities, which has been significantly enhanced by the company's tax payments to the City, the park district, and the school district; and

2. The company's donation of a building for use as a community center, and the donation of a 5.7 acre parcel of land which has been developed for use as a baseball field.

The impacts which have been generally negative include the following:

1. The loss of certain open space resources resulting from the development of the refinery on land on the north side of the town which had previously been used as farmland and undeveloped open space;

2. The loss of most of the Baby Beach area resulting from the development of the refinery's marine terminal, which had previously been used by bathers;

3. Deterioration in the already heavily-deteriorated quality of water in the Delaware River resulting from the refinery's waste water discharges, especially prior to the 1970's, which has contributed to unhealthy conditions relative to swimming and fishing;

4. Destruction of two historically significant structures in the Delaware City area, which were an important part of the community's historical and cultural heritage; and

5. The potential indirect loss of recreational and cultural opportunities available to tourist visitors resulting from the existence of unpleasant odors and negative visual perceptions, which may tend to diminish the attractiveness of the town as a place to visit and enjoy.

RECOMMENDATIONS

The following recommendations are presented to accomplish three objectives relative to recreational and cultural opportunities: (1) to improve and enhance the public's accessibility to existing opportunities; (2) to protect and preserve existing opportunities; (3) to replace, where possible, opportunities which have been lost as a result of modern development or environmental degradation. Accordingly, it is recommended that the Mayor and Council of Delaware City, in conjunction with other interested groups, seek the implementation of the following actions:

1. It is recommended that financial support be sought to complete the improvement of recreational facilities on City-owned parkland, wherever such facilities are currently incomplete. In addition, steps should be taken to increase the accessibility of recreational and cultural facilities to the public, targeted primarily to the following facilities:

   a. The baseball field on the Clark's Corner to Delaware City Road (Getty-donated parcel), which currently has accessibility barriers for bicyclists and pedestrians; and

   b. The Delaware City Touch Museum, which currently has accessibility barriers due to inadequate financial support and volunteer staffing.

2. In order to preserve and protect the community's rich architectural and cultural heritage, it is recommended that the following strategies be implemented:

   a. The renewal of efforts to obtain official designation of a historic district in Delaware City from the National Trust for Historic Preservation; and

   b. The establishment of a historic district zoning classification, to be incorporated into the existing Delaware City Zoning Code.

3. In order to replace recreational opportunities which have been lost as a result of modern development and environmental degradation, it is recommended that a water-based recreational facility be planned for development on City-owned property along the Branch Channel of the Chesapeake and Delaware Canal (Old Canal). Such a facility could be planned to include swimming, fishing, and a public launch area for boats. The water quality in the Old Canal has been determined to be considerably better than water quality in the Delaware River, and could therefore provide healthier conditions for both swimming and fishing. The State of Delaware can make a small dredge available to local communities to excavate and deepen small areas. The State Soil and Water Conservation office will schedule the use of the dredge and make appropriate arrangements with the U. S. Army Corps of Engineers. A proposal should be sent, and the local State Representative must be kept informed.

CHAPTER NOTES

1 U. S. Department of the Interior, Bureau of Outdoor Recreation, How Effective Are Your Community Recreation Services? (April 1973), p. viii.

2 New Castle County Areawide Waste Treatment Management Program, Cultural and Aesthetic Resources (Position Paper 33, May, 1977), p. 3.

3 Efforts to save the building were being undertaken by the Delaware City Historical Society. At the same time, an effort was underway to establish a statewide Historic Preservation Revolving Fund. The Marl Dale house had been designated as a priority site for protection by targeting monies through the revolving fund, once established.

CHAPTER 15

POTENTIAL FOR DISASTER

INTRODUCTION

The operation of a major petroleum refinery, by the very nature of the volatile chemicals and processes involved, represents an ever-present safety hazard. Fire presents a particularly acute danger where large volumes of petroleum products are contained, as is the case at Getty's marine terminal and at the refinery tank farm. Although a fire itself may be easily contained, the intense heat generated by the combustion of fuel oil and other petroleum products presents the distinct potential for explosion.[1] In addition to fire and explosion, there is also the threat of the formation of a vapor cloud of explosive gases which could spread away from the refinery site and spontaneously ignite or cause respiratory injuries or even fatalities elsewhere.

For the purposes of this analysis, disaster will be defined to include any refinery-related fire, explosion, or vapor cloud incident which has the potential to pose an immediate threat to the health and safety of people located or residing in adjacent and nearby areas, and which also has the potential to create substantial property damage. Based on this definition, a serious spill will only be regarded as a disaster situation to the extent that the spilled material has the potential to ignite. The impact of non-combusting spills is discussed in the Water Resources Impact Analysis (see pages 63 to 65). These types of disasters could occur at several different possible locations, result from several causes or factors, and assume a wide range of degrees of severity and degrees of impact upon the adjacent community. An explosion and/or a fire could occur at the refinery itself; in the pipelines extending from the terminal area to the refinery; at the terminal area, including the dock area and any ships anchored at the dock; and in the river itself if a ship or barge explodes or spills a liquid which catches fire on the water. According to Lieutenant Paul C. Golden of the U.S. Coast Guard, "In terms of risk of life, fire and explosion represent the greatest potential for death and destruction in the area immediately surrounding the scene of the accident. However, toxic vapor clouds, especially if they are heavier than air, can represent the greatest risk of life to a metropolitan area."[2]

The assessment of the potential for disaster at the Getty refinery will proceed by presenting four specific areas of concern relative to the disaster issue. They include:

- Identification of disaster potentials, including specific types of disasters which could occur and an assessment of the probability of their occurrence;
- Assessment of current plans, procedures, and policies which have been implemented to prevent, or respond to, emergency situations in which a potential for disaster exists;
- Assessment of the potential impact on Delaware City if a major disaster were to occur, taking into consideraton the effect of currently-implemented emergency plans, procedures, and policies; and
- Recommendations of policies and procedures not currently in effect, designed to reduce the likelihood of serious impacts upon Delaware City.

IDENTIFICATION OF DISASTER POTENTIALS

Types of Refinery Disasters

Research into refinery-related accidents within recent years has revealed that a number of different types of disasters have occurred. A considerable number of accidents (fires, explosions, etc.) have been reported by the Oil and Gas Journal and other sources, within the past seven years. The incidents chronicled below, although they

do not in any way represent an exhaustive accounting of all such incidents during this time period, are presented to serve as examples of incidents which could occur at the Getty Delaware City refinery complex.

January 1975—tanker collision and fire at the B. P. Marcus Hook Refinery

A chemical tanker rammed an oil tanker while the oil tanker was discharging crude at British Petroleum's Marcus Hook, Pennsylvania, refinery. The tanker contained 300,000 barrels of oil when it was struck. The resulting series of explosions and fire left three dead, 30 injured, and 27 missing. Flames reached 500 feet into the air and continued to burn for a week. The prevailing wind prevented the fire from reaching the tank storage area. The damage to the oil tanker was extensive, although the chemical tanker was only slightly damaged.

February 1975—fatal gas leak at Arco injection well in Texas

Nine persons died from exposure to poisonous gases, including one Arco worker, at an Arco injection well in Yoakum County, Texas. It was originally believed that a slow leak of carbon dioxide, too slow to activate a safety valve, was responsible for the fatalities. It was later determined that hydrogen sulfide, an invisible highly toxic gas, was mixed with the CO_2. Hydrogen sulfide, which is given off during the production and refining of oil with a high sulfur content, can cause rapid respiratory paralysis and subsequent death. Many farm animals within range of the leak were also killed. Despite extensive safety precautions, the danger involved is still great. According to a Wall Street Journal article (December 5, 1975), because of the increased use of high-sulfur crude oil, "The hazard to those employed in the production, transportation, and refining of hydrocarbons, and to those who live near oil fields or refineries is potentially greater than ever." At least ten oil company employees were killed in 1973 and 1974 as a result of exposure to hydrogen sulfide.

August 1975—major fire at Gulf Philadelphia refinery

A major blaze at Gulf's South Philadelphia refinery caused $10 million in damage to storage tanks, administration buildings, and the utilities stack, and closed down the refinery. The fire broke out while a tanker was discharging oil into a storage tank. After the blaze was brought under control, a second blaze ignited, which burned nine days, killing eight and injuring 11 Philadelphia firefighters. Cause was not immediately determined.

October 1975—major fire at Arco Philadelphia refinery

A major fire in the gasoline blending and storage areas of Arco's South Philadelphia refinery caused a 50 percent production cutback and more than $1 million in damage. The fire started in conduits which contain pipes connected to tanks in the storage area and spread to a tank containing 38,000 barrels of an alcohol mixture. No deaths were reported, even though the fire burned out of control for 18 hours.

October 1975—fire at Phillips refinery in California

The second fire of the year at Phillip's Martinez, California, refinery, this time in the coking unit, was extinguished in 75 minutes and caused no injuries. However, the fire resulted in an extensive production reduction. The earlier fire, in March, occurred in the feed surge tank and had reduced production by 75 percent at that time.

October 1975—fire at Gulf Philadelphia refinery

The 180,000 barrel/day Gulf South Philadelphia refinery was temporarily closed after a fire in the pump house, resulting from a pump failure. Damage was confined to the pump house. There were no injuries. This was the second incident at the refinery within a three-month period.

February 1976—rupture of MAPCO LP-Gas Line, Lubbock, Texas

A rupture in a liquified petroleum gas line caused an explosion which killed four residents of nearby mobile homes. The explosion occurred when a vapor cloud spread away from the line and ignited. Most local area residents were evacuated.

July 1976—fire at Cosden Oil Company refinery at Big Springs, Texas

An explosion occurred in the heavy fuel oil blending tank at the Cosden's 60,000 barrel/day refinery. Fire spread to the treating, blending, and alkylation units and was finally brought under control after six hours. There were no major injuries. Cause of the explosion was not disclosed.

August 1976—workmen killed repairing pipeline (NTSB report)

A National Transportation Safety Board report was issued concerning a 1974 incident in which six of seven workmen were killed attempting to repair a weld in a pipeline belonging to the West Texas Pipeline Company. The report indicated that several basic safety procedures, including shutting down the pipeline, were ignored. As a result, crude oil fumes spread into the air and formed a deadly haze, which felled the workers.

December 1976—major tanker explosion in Los Angeles Harbor

A tanker explosion at the Union Oil Company marine terminal resulted in four deaths and several persons missing. Little oil escaped from the tanker itself, but 120,000 barrels spilled from storage tanks, necessitating extensive clean-up operations. Damage to the port and onshore establishments was estimated to be in the millions of dollars. The accident occurred after the cargo had been discharged and 25,000 barrels of fuel oil for the return trip to Indonesia had been loaded. As a result of the explosion, which was heard 40 miles away, the vessel broke in half. Part of the vessel landed on the pier and holes were ripped through the dock. It was later determined that a spark had ignited gases in empty storage tanks in the tanker, although the cause of the spark was unknown.

April 1977—blast and fire damage plant in Qatar

An explosion and fire at a liquified natural gas plant killed six employees and injured 13. The gas gathering, processing, and fractionation plants were heavily damaged. No details concerning the cause of the accident were provided.

March 1978—barge explosion at Getty Delaware City pier

On March 20, 1978, a barge in the process of being loaded with jet fuel exploded and burst into flames. It was towed away from the Getty pier by a tugboat and eventually sank in the Delaware River.[3] Two men were killed and

one injured. The Delaware City Fire Department responded to the alarm, as did 100 Getty employees and six other area fire departments involving 150 firefighters. Ignition of explosive vapors in one of the barge's cargo tanks was judged responsible for the explosion. Cause of the ignition was not determined, although no misconduct, neglect, or mechanical failure was detected.

June 1978—explosion and fire at Texas City, Texas, refinery

Six workers were killed and heavy damage was sustained as the result of an explosion and fire at the Texas City Refining Company's 120,000 barrel/day refinery. The refinery was forced to close for three weeks. Cause of the explosion was not immediately determined.

September 1978—fire at Syncrude refinery, Canada

A fire at the Syncrude refinery stopped the production at the 60,000 barrel/day facility. A gasket leak at the base of the fluid coking unit released hot oil, which ignited. Damage was reported as minor, and there were no injuries.

January 1979—tanker explosion at Gulf's Bantry Bay, Ireland, refinery

An explosion sank a tanker which had been discharging crude at the Gulf refinery in Ireland, killing the crew of 43 and seven Gulf employees. The tanker had discharged 70,000 barrels of oil; 40,000 were still on board. The explosion destroyed the main jetty and transshipment terminal, although the terminal storage tanks, containing 4.5 million barrels of oil, were unharmed. The ten-year old tanker had not been fitted with an inert gas system to prevent the build-up of explosive vapors during unloading. A subsequent investigation by the Irish government identified other deficiencies in the tanker, including serious corrosion, lack of cathodic protection, and inadequacy of general maintenance. It was also determined that a senior Gulf employee was away from his duty post when the incident occurred. The lack of an emergency evacuation plan was also cited as a contributing cause to the severity of the disaster.

April 1979—fire and explosion at Conoco's Colorado refinery

The Conoco refinery in Commerce City, Colorado, (32,500 barrels/day) was heavily damaged by a fire and explosion. No details about the incident were reported.

April 1979—fire and explosion at Texas refinery dock

Lightning was blamed for the explosion and sinking of a 124,000 dead weight ton tanker at the Sunoco dock in Port Neches, Texas. The casualties included one death, one missing, and seventeen hospitalized. The tanker had just finished unloading when the lightning struck, causing two explosions which set four other tankers on fire and extensively damaged the dock.

June 1979—fire damage at Arco's California refinery

A fire at the Arco refinery in Carson, California, was caused by a leak of hydrogen gas from a compressor. The damage was not severe, but caused a cut in production.

June 1979—fire at Chevron's California refinery

A fire at the ground flare caused a one-day shutdown of the Chevron El Segundo refinery. It was determined that a mechanical failure at the crude unit caused the relief system to flood with crude, which caused the flare to erupt into uncontrolled flames.

July 1979—explosion and fire at Amoco's Texas refinery

An explosion and fire at the Amoco refinery in Texas City, Texas, knocked out two gasoline refining units. The accident, caused by a propane or butane leak, caused injuries to fourteen Amoco employees and two volunteer firemen. The fluid catalytic cracker and aklylation unit were damaged.

September 1979—tanker explosion at Shell Texas refinery

Nearly simultaneous explosions occurred aboard a 70,000 dead weight ton tanker and a storage tank holding 30,000 barrels of ethyl alcohol at Shell's Deer Park, Texas, refinery. Although the cause was not determined, witnesses saw lightning strike just prior to the explosions, which resulted in two deaths, one missing, and twelve injured. The tanker had unloaded 78,000 barrels of its 128,000 barrel cargo, but unloading had stopped because of the approaching storm. The fire spread from the tanker to two other docks and four barges loaded with crude and gasoline. The blaze was fought for several hours by 350 firefighters. In addition, 5-10,000 barrels of oil spilled into the water.

January 1980—explosion at Phillips refinery in Texas

An explosion at the Phillips 100,000 barrel/day refinery in Borger, Texas left 39 injured. The blast ripped through two cracking units; a fireball was sent 300 feet into the air. Cause of the explosion was not immediately determined.

May 1982—explosion at refinery in Louisiana

A series of explosions at a refinery in Cotton Valley, Louisiana, resulted in several injuries and the evacuation of 3,000 nearby residents, as shrapnel from the refinery was hurled as much as a quarter mile.

Probability of Occurrence at the Getty Refinery

All of the above incidents have been determined to have the potential to occur at Getty's Delaware City refinery. These incidents have involved such equipment or facilities as storage tanks, refining units, pipelines, valves, barges, and tankers, all of which are employed at the Getty refinery. Moreover, each of these incidents has involved either human error, equipment failure, poor weather, and/or unidentifiable factors which have contributed to the occurrence of the incident. The Getty refinery is no more immune to these factors than any of the other refineries were. In fact, there have been several fires at the refinery over the years, including the barge explosion disaster reported above.

The problem lies in the unpredictability of most incidents, which are not always caused by factors which can be monitored and controlled. Indeed, the spontaneous and totally unexpected nature of many refinery accidents contributes to their seriousness. Furthermore, because of the relatively short history of the operation of many oil refineries (many refineries have as yet had no major accidents) and the great number of

factors which can contribute to causing or preventing an occurrence, predictability is difficult, if not impossible. According to one expert source:

> "Assuming the levels of risk normally considered to be acceptable and the frequency of major catastrophes, it would take thousands of years to establish the risk level of some hazards solely by observation. Clearly, planners cannot simply rely on experience alone to evaluate disaster risk."[4]

Still, it is possible to reduce the uncertainty concerning the degree of risk facing the community in the event of an accident at the refinery. The degree of strictness in Federal, State, and local safety regulations, the amount of safety precaution exercised by workers, and other factors help determine how great the potential for disaster is.

At the same time, it must be realized that no matter how extensive the safety precautions and no matter how much the possibility of human error is reduced, the potential for a refinery-related disaster cannot be completely eliminated. Under the "right" conditions, the best designed and constructed refining unit, storage facility, valve, pipeline, barge, or tanker, may fail.[5]

Some inferences concerning the extent to which risk can be reduced can be made from existing information. For example, the chronology of reported incidents appears to indicate a decline in the seriousness of refinery disasters in the most recent years. This may be due, in part, to improved operational practices by refinery and transport operators. In addition, the Port and Tanker Safety Act of 1978 (P.L. 95-474) establishes stringent safety requirements and inspection procedures for tankers serving American ports, beginning in 1983. This should further improve safety at marine terminal areas, including the reduction of oil spillage.

All of the firefighting and emergency management experts consulted as part of this study agreed that if the existing safety regulations are strictly adhered to, and if the commitment to safety on the part of the company, its employees, and various public and private sector safety inspectors does not diminish, even briefly, then the chances of a major disaster at the Getty refinery are small. However, these experts also agreed that some accidents are inevitable. Judging from the 26-year history of the operations of the refinery, it can be reasonably projected that isolated, minor occurrences will continue to periodically take place. The probability of a major disaster, while acknowledged to be small, is nevertheless real and ever-present. This assessment is based on the historical record involving all refineries, as detailed earlier, as well as the record of the Getty refinery itself, which has experienced at least one major disaster in its 26 years of operation. Even the minor occurrences, because of the nature of what is involved, have the potential to become major disasters.

EMERGENCY PREPAREDNESS

Safety Precautions and Disaster Prevention

The Getty refinery has made a substantial investment in equipment, manpower, and comprehensive procedures to minimize the threat of an emergency situation. In the event of a fire, explosion, or other emergency situation, the Getty Fire and Safety Department and other firefighting and emergency units are well-trained, equipped, and organized to contain the problem. Moreover, the refinery's process equipment itself, in many cases, has been designed to achieve this objective.

According to all experts who were interviewed, Getty's safety procedures are extensive. Before any repair or maintenance activity on any unit can take place, especially welding and burning, an inspection is conducted to make sure the unit is prepared for maintenance, and an entry permit must be granted by the Fire and Safety Department. Each storage tank is protected by a floating, sealed top, which prevents the build-up of explosive vapors. A boiling liquid explosion is considered almost impossible because automatic sprinklers would be activated. The propane transport trucks are also equipped with photoelectric sprinkler systems, to minimize dangers during loading or unloading. Regular inspections are conducted on piping, valves, pumps, and pipe and tank metal thickness.

Getty believes its firefighting equipment is the best of any industrial plant in the country and plans to improve its equipment to take advantage of the latest technology. In addition, it is reported that the staff of the Fire and Safety Department demonstrates a high level of expertise and commitment, and the stated aim of the Fire Chief is to keep morale high on his staff. The specialized nature of their duties gives these firefighters an advantage over personnel fighting an ordinary building fire, since the refinery firemen know exactly what is burning and how to extinguish it. Getty has instituted a new method for dispatching foam to improve the speed and logistics of using it when needed. The Getty refinery was the first to obtain a ladder tower, which can be used for both firefighting and rescue. At least one fire inspector is on duty 24 hours a day, seven days a week, and in addition, a "monitor gun" (a mechanical firefighter) is positioned at all tanks.

In the event that a fire or other incident cannot be contained and terminated through the initial efforts of the Getty Fire and Safety Department, there is a plan and set of procedures which have been implemented to set in motion a higher level of response, by engaging other firefighting units in the County, all of which are well-trained in responding to refinery emergencies. As a result of this comprehensive arrangement, emergency management experts at Getty and the New Castle County Department of Public Safety are confident that even incidents beyond the company's capability to control alone, will still be contained long before posing a threat to the community. This arrangement is discussed in greater detail in the next section.

Based on the considerations discussed above, it can be concluded that the risk to Delaware City in the event of a fire or explosion at the refinery has clearly been minimized, particularly if the incident occurs at the main refining and storage area. Furthermore, the risk to the town of a pipeline explosion is also minimal. The chance of this happening has been reported to be remote and, if it did happen, the liquid flow would be terminated immediately to prevent the build up of potentially lethal vapors.

However, a fire or explosion at the marine terminal could result in more serious consequences. Tankers and barges carrying crude and refined petroleum products present serious fire and explosion hazards, especially when they are loading and unloading, because of the accumulation of vapors. As shown by the chronology of incidents, many of the major refinery disasters have occurred at pier areas, including the barge explosion at the Getty terminal in 1978. There is no land-based firefighting equipment which could combat a burning tanker without great risk of loss of life. It is believed by firefighting experts that the best approach is to allow an engulfed vessel to burn, especially if the wind conditions are favorable.

According to the Getty Fire and Safety Department, a tanker or barge explosion and/or fire would be unlikely to destroy anything other than the pier it was docked at. Even the pipeline and storage facilities at the terminal are believed to be safe. After the 1978 barge explosion, the product lines were immediately shut off to prevent further

ignition. Other preventive safety measures have been adopted. In addition to the Port and Tanker Safety Act of 1978 previously mentioned, it is required that tankers be kept inert and that the flue gas be diverted to keep oxygen out of the tank during loading and unloading. Nevertheless, in light of the higher degree of potential hazards associated with marine terminal operations, and in light of the close proximity of the terminal to built-up parts of the town, the consequences of an accident at the terminal can be considered to be potentially serious.

Emergency Response Mechanisms

The resources available to respond to any emergency at the Getty refinery are extensive and are all part of a well-coordinated system. The effectiveness of the system depends primarily upon the clear thinking of the persons in charge, who are responsible for the decision to activate the emergency procedures. It is often the case that a minor incident can be fully controlled by Getty's in-house staff and in these cases, no additional response is utilized. However, if additional assistance is required, the refinery has a direct tie-in with the New Castle County Fireboard. The refinery is divided into three zones so that the County Communications Center (located near New Castle) knows exactly where the problem is occurring. The Communications Center dispatches equipment, administers the New Castle County Emergency Operating Plan, and coordinates communications with other emergency services. The Emergency Plan calls for a minimum response to an industrial accident which consists of two engines, a rescue company, a truck company, and one ambulance for each alarm. On the first alarm, the Delaware City and Christiana fire companies would be dispatched. The Odessa company would be dispatched on the second alarm. The fourth alarm constitutes a general alarm emergency. According to the New Castle County Department of Public Safety, there have been two general alarm fires in the past 15 years at the Getty refinery.

When extensive emergency operations are required, the County Director of Public Safety becomes the person-in-charge. Plans or parts of plans can be implemented and the Director of Public Safety can authorize the pooling of an extensive variety of emergency response resources. For instance, there are mutual aid agreements between fire companies in the County and between the contiguous counties. Also, the Wilmington Medical Center has an emergency plan to coordinate ambulance services and hospital admissions, and the County Police, the Red Cross, and the Salvation Army also have emergency procedures which would be followed upon the directive of the Director of Public Safety. If the evacuation of Delaware City was deemed necessary, then the evacuation procedures detailed in the state of Delaware Radiological Emergency Plan and Implementation Procedures (1981) would be followed.

The key to successful implementation of the County Emergency Operating Plan is prompt notification of the County authorities, since in some cases substantial distances would have to be overcome to respond to an emergency at the refinery. For example, Delaware City has only one ambulance. New Castle, Odessa, and Middletown are the only nearby municipalities with ambulance companies, and the nearest hospitals are located in Wilmington. On the whole, the procedures are designed to be activated smoothly and in sequence, with all agencies working together. Officials of the County Department of Public Safety contend that although a "worst case" scenario for a refinery disaster is unknown, the resources that could currently be employed are believed to be adequate. Only the extremely remote possibility of simultaneous disasters at opposite ends of the County could pose a true threat to the response infrastructure.

However, there is reason to believe that the ability to combat a fire at the marine terminal piers or in the turning basin adjacent to the piers is less comprehensive than claimed. Getty does not own a fireboat, and an arrangement whereby Getty would have

been able to outfit Wilmington's fireboat with foam was never executed. Currently, Wilmington's fireboat is out of service, and the next nearest one is in Philadelphia. According to the Getty Fire and Safety Department, there is a Tri-State Refinery Mutual Aid Agreement (including Delaware, New Jersey, and Pennsylvania) but there is still currently a three-hour gap in getting a fireboat to assist the firefighting at Delaware City. Even the Coast Guard, which patrols the waterway, is not always able to respond quickly enough. Since it is generally very difficult to fight these types of fires from onshore, the prevailing technique is to allow the fire to burn, since it would only burn until the fuel is consumed. Because of the inherent danger of a burning substance on the water, it would improve the overall safety of Delaware City if this aspect of emergency response could be upgraded.

In conclusion, the level of emergency prevention and response preparedness, as presented to the Consultant, appears to be high. There has been substantial investment in safety mechanisms and firefighting technology and much planning has taken place so that an emergency situation can be met in an effective manner. However, the fact that all of the technology and procedures are dependent upon proper functioning and upon human decision-making (and are therefore subject to human error), leaves open the possibility of unforeseen difficulties in the event of an emergency. This is especially noteworthy with respect to waterfront accidents, which have been shown to be the most hazardous, the least combatible, and as discussed in the next section, the most potentially harmful to Delaware City.

POTENTIAL IMPACTS ON DELAWARE CITY

Immediate Impacts

It has been determined that because of the distance involved and the elaborate safety and emergency response procedures in effect, the threat to lives and property in Delaware City itself in the event of an explosion or fire at the main refinery and storage area, is minimal. Such an occurrence would likely result in the closing of Route 72 and/or Route 9 to the public until the emergency was controlled. This would be an inconvenience to Delaware City residents, but would not enclose the community, as Route 9 south of the refinery would be unaffected.

However, if a major explosion were to occur at the marine terminal area, Delaware City could be affected in several ways. At the least, some windows in the buildings near the terminal would be blown out. If the wind was blowing toward the town, smoke from the resultant fire would envelop the business district. Under the worst wind conditions, it is conceivable that the fire could spread as well, since there are buildings in the town that are within several hundred yards of the terminal. If the river currents were travelling towards Delaware City, there would be the threat of a vessel engulfed in flames drifting and thereby possibly causing damage to the waterfront and nearby buildings. This is certainly the most serious threat to Delaware City involving a fire or explosion at the Getty refinery, since the waterfront area is vital to Delaware City's economy, particularly the tourist trade and the boating industry, as well as an important historic and recreation site. Any permanent damage to the waterfront area would be a severe blow to the town.

A second possible threat would be from the formation of a vapor cloud of toxic gases, which could spread away from the affected pipeline, barge, or tanker and, conceivably, ignite in Delaware City. According to the firefighting experts consulted, this would be a remote possibility, and if a vapor cloud did form, it is maintained that it could be dissipated.

A third, potentially serious possibility is the threat of a spill igniting and spreading on the river. If such a fire were to spread toward the town's waterfront or into the Old Canal Channel, it would be a major fire fighting problem. Again, however, this possibility has been termed remote. Furthermore, spill fires themselves are unlikely. According to the American Petroleum Institute,

> "A fire hazard may be created by a spill of readily ignitible oil and the area of fire danger may enlarge as such a spill spreads across the surface of a waterway. Yet, the experience of many years with petroleum as an article of commerce has shown that spills not ignited at their inception are seldom accidentally ignited. Moreover, after a spill has occurred, sufficient spreading and evaporation even makes deliberate ignition impossible."[6]

The cool temperatures of the water would serve to keep the oil temperature below its ignition point. In addition, as the oil spreads, much of it evaporates or sinks, thus lowering the chance of ignition. Regarding oil vapors:

> "During the early stages of a nonconfined finite spill, flammable vapors may extend beyond the edge of the area of visible oil. However the vapors will rather quickly dissipate. . .In the case of confined or continuous spills, flammable vapors will persist until the spill has been stopped or until considerable weathering has occurred. . .The vapor concentration gradient at the surface of an oil spill is ordinarily so steep that vapor in hazardous concentrations usually will not be carried downwind. Unless tests show positive evidence of dangerous vapor spread, evacuation of downwind areas normally is not necessary and will delay control processes."[7]

Although an oil spill can be seriously damaging even if it does not ignite, there is a strong remedy mechanism in effect now, as a result of the passage of the Comprehensive Environmental Responses, Compensation, and Liability Act of 1980 (P.L. 96-510). This legislation establishes liability for cleanup and compensation for damages that occur when hazardous substances are released into the environment. The persons or company responsible for a spill must immediately contact the National Response Center. The President (of the United States) is empowered to take action necessary to protect the public and direct the Attorney General to get an abatement order against any existing or proposed actions. More importantly, the offender[8] is liable for all removal costs, remedial action, and other necessary costs associated with the National Contingency Plan. The offender is also liable for damages in the event of injury to or destruction of natural resources.

After analyzing these potential impacts, it has been concluded that any large fire at the terminal or on the Delaware River is a greater threat than the low probability of occurence would indicate. This assessment is based on the fact that the ability to quickly contain or extinguish a fire under these circumstances is not nearly as high as at the main refinery area, nor are the extensive safety procedures as strong a guarantee against a major accident as they are at the main refinery. The confidence of the fire fighting experts depends on factors such as wind direction, tidal flow and the properties of the various chemicals which historically have behaved in certain ways, but cannot be controlled. As has already been shown, pier-related refinery accidents are generally spontaneous and their causes and consequences are unpredictable. Therefore, it is crucial that the greatest degree of preparedness be exercised in anticipation of this type of disaster.

Long Range Impacts

In the long run, following a mishap of major proportions, the community might be affected in several ways. According to well-documented disaster research efforts, psychological impacts could be expected to be prominent among these long-range impacts. A major refinery accident would most likely create a sense of fear and anxiety among Delaware City residents relative to the safety of their community, as other major industrial accidents have done in other places. In addition, feelings of distrust and animosity toward the refinery and its operators on the part of Delaware City residents would likely become magnified, thus creating a very strained relationship between the company and the town, which would be difficult to overcome. The image of Delaware City itself would undoubtedly suffer; rightly or not, a refinery disaster would alter the perception of Delaware City as a safe, peaceful place to live, work, or even visit. Although the community could eventually rebound, as have many other communities affected by natural or man-made disaster, the psychological scars would likely remain.

Finally, equally serious potential long-range economic effects would result if the mishaps involved the destruction of resources crucial to the town's well-being. Specifically, an explosion or fire at the marine terminal area could result in major damage to Delaware City's waterfront area. This would be a real detriment to the town because of the importance of the waterfront to tourism and recreation, and could seriously undermine the commercial and cultural viability of Delaware City.

Although consequences of this severe a nature are not expected to occur, it would be advisable for the community to be as well-prepared as is practical. In the following section, recommendations are proposed for upgrading elements of the emergency preparedness and disaster response mechanisms.

RECOMMENDATIONS

In light of the findings of the preceding analysis, the following recommendations are made, to reduce the threat to Delaware City of a refinery-related disaster:

1. It is recommended that the Mayor and Council of Delaware City request the Getty Refining and Market Company to acquire a boat with firefighting capability. At present, there is an inadequacy in combating tanker or barge-related fires. These fires cannot be effectively controlled from land, and since the City of Wilmington's boat is not available to the refinery, there is a substantial lag in response time before a boat could be employed in firefighting. It has been pointed out that a firefighting boat could also serve as a tug boat, thus increasing the productivity of the acquisition for the company, while greatly reducing the possibility of serious damage to Delaware City's waterfront area.

2. It is recommended that the Mayor and Council of Delaware City and other interested groups should, independently of Getty, procure the financial and technical expertise to develop an emergency plan, to be implemented in case of a refinery fire or explosion. While existing plans are directed at containing emergencies at the refinery, there is little attention given to what should be done in surrounding areas. In order to anticipate "worst case" scenarios, it is recommended that Delaware City adopt its own planning mechanism to anticipate possible consequences and to prepare a strategy in advance, to avoid or minimize these consequences. This is essential because, due to the very low probability of any refinery accident seriously affecting Delaware City, any additional major investment by the refinery in safety infrastructure, beyond a boat, is not likely to occur. Although Getty is committed to upgrade its own equipment and to

maintain the finest firefighting apparatus available, it is unlikely that either Getty or any public safety agency would expend additional money to prepare for an emergency with a very low probability of occurrence. This type of stockpiling would be considered too costly and unmanageable. Therefore, it is incumbent upon Delaware City to plan for these possibilities in advance so that it will be in a better position to recover if such a circumstance ever arose. This type of planning should include an assessment by a firefighting expert independent of Getty or any local or state agency.

3. The Mayor and Council of Delaware City, in conjunction with the Delaware City Volunteer Fire Company, should seek the financial support to increase the ambulance service in Delaware City. The existence of only one ambulance is the most obvious gap in emergency preparedness in a community so close to several sources of danger. Although other ambulance services could be mobilized fairly quickly, the mere fact of the distances between Delaware City and the health care centers in Wilmington requires that ambulances be available to the City as fast as possible. In the event of a major explosion at the Getty pier, there could be many injuries resulting from flying glass and shrapnel, smoke inhalation and other causes. One ambulance is not sufficient in light of these possibilities.

CHAPTER NOTES

1 New England River Basin Commission, Onshore Facilities Related to Offshore Oil and Gas Development Factbook (Boston, MA: New England River Basin Commission, 1978), p. 6-48.

2 Lt. Paul C. Golden, "Water Transportation Risks of Hazardous Materials," in Utilization of Science in the Decision-Making Process. (Arlington, VA: The Coastal Society, 1980), p. 74.

3 The U. S. Coast Guard Report indicates that the barge was towed away. However, the New Castle County Department of Public Safety emphatically insists that the barge was not towed away, but was carried by the prevailing tides into the river away from the pier.

4 K. V. Steinbrugge and V. R. Bush, "Review of Earthquake Damage in the Western United States, 1931-1964", in D. S. Calder, ed., Earthquake Investigations in the Western United States. (Washington, DC: U. S. Department of Commerce, 1965).

5 Golden, p. 75.

6 Fire Hazards of Oil Spills on Waterways. (Washington, DC: American Petroleum Institute, 1977), p. 1.

7 Ibid, p. 3.

8 The offender is defined as the owner or operator of the vessel; or the owner of the facility where the hazardous material was dumped; or the person who has contracted for disposal or treatment.

CHAPTER 16

GENERAL CONCLUSIONS: SUMMARY OF PHYSICAL, ECONOMIC, AND SOCIAL IMPACTS

INTRODUCTION

The preceding set of physical, economic, and social impact analyses has been extensive and far-reaching, and has resulted in the identification of a number of complex issues. In an effort to consolidate and simplify the results of these analyses, all identified impacts are presented which have been discussed earlier. In addition, each impact is identified as being either beneficial (positive) to Delaware City, adverse (negative) to Delaware City, or neutral.

SUMMARY OF COASTAL ENERGY ACTIVITY IMPACTS

Shoreline Erosion and Flood Hazard Impacts (Chapter 4)

It has been determined that shoreline erosion and flooding problems endured by Delaware City are not the result of the refinery's operation.

Nature of Impact: Neutral.

Air Quality Impacts (Chapter 5)

1. It has been determined that sulfur dioxide and suspended particulates originating from the refinery, currently reach Delaware City on a frequent basis. At the same time, the levels of these and other emissions in the ambient air are consistently within established State standards.

Nature of Impact: Negative.

2. A survey of a sample of Delaware City households revealed that 97 percent of the respondents experienced unpleasant odors in the air around their homes on a recurrent basis. The Getty refinery has been identified by State officials as a frequent source of reported odor complaints.

Nature of Impact: Negative.

Water Resource Impacts (Chapter 6)

1. Getty groundwater pumpage has resulted in a permanent draw-down of water levels in the system of nearby Potomac aquifers, from which Delaware City receives its water supplies. As a result, it is believed to be more costly to the City to pump its water to the surface than it would be if Getty were not withdrawing the amount that it does. However, it must be pointed out that Getty has been using these aquifers longer than Delaware City has, and therefore cannot be held liable for the resulting impact.

Nature of Impact: Negative.

2. Because of the magnitude of Getty's pumpage from the Potomac aquifers, recently averaging 3.75 million gallons per day, the migration of salt and other contaminants, found to exist in portions of the aquifer system in the vicinity of New Castle, may be accelerated in the direction of the Delaware City area. However, no problem is anticipated in Delaware City's water supply for decades, if at all, and would probably affect Getty first.

Nature of Impact: Potentially Negative.

3. Getty's discharge of treated waste water effluent into the Delaware River results in simultaneously positive and negative impacts on the quality of river water in the vicinity. While this effluent has significantly less BOD content than the receiving water, it has a higher oil and grease content. In addition, other pollutants are also discharged, including ammonia, phenols, sulfides, and metals. There is insufficient data to determine the net impacts of these pollutants. Getty's discharges have been in consistent compliance with established standards under their National Pollutant Discharge Elimination System (NPDES) permit, administered by the State of Delaware.

Nature of Impact: Positive relative to some pollutants, Negative relative to others.

4. Getty's procedures for the land disposal of solid wastes, including sludge from the waste water treatment plant, have been determined to be generally sound and are currently being improved even further. To the extent that the company landfills or landfarms its sludge, it implies that less pollutants are being discharged into the Delaware River. However, dredged spoils materials which were disposed of at excavated locations on the refinery property and which now serve as the lining for the landfill, may be contributing to a higher salt content in the water table aquifer.

Nature of Impact: Neutral.

5. Getty's marine transfer activities result in periodic low-level spillage of hydrocarbons into the Delaware River. Despite clean-up technologies, a portion of these hydrocarbons will be absorbed by the marine environment, thereby creating potential damage to marine life. Moreover, the potential exists for a large-scale spill resulting from a docking collision or explosion.

Nature of Impact: Negative.

6. Getty's frozen earth underground storage of propane, while generally superior to conventional above-ground storage, has the potential, under extreme and speculative conditions, to result in the leakage of hydrocarbons into groundwater resources which discharge into local surface water bodies. While there would be little or no threat to drinking water supplies, the possiblity exists for damage to marine life.

Nature of Impact: Potentially Negative.

Visual Quality Impacts (Chapter 7)

Refinery structures, fixtures, and other equipment create a significant visual encroachment along major entrance roads to Delaware City, particularly from the northwest. While the refinery is not visible from most points once inside Delaware City, the marine terminal area and the barbed wire fencing which surrounds it, detract from an otherwise aesthetically-pleasing vista at Battery Park.

Nature of Impact: Negative.

Land Use Impacts (Chapter 8)

Getty land uses relative to the operation of the refinery do not create identifiable positive or negative impacts on other land uses within the community. However, Delaware City's Zoning Code has been determined to exhibit certain inconsistencies and inadequacies relative to the effective regulation of Getty's land uses.

Nature of Impact: Neutral.

Health Impacts (Chapter 11)

The establishment of a clear causal relationship between air and water pollution emanating from the Getty refinery on the one hand, and specific health deficiencies of the residents of Delaware City on the other, is not possible at the present time. However, it has been determined that New Castle Countians in general have unusually high incidence rates for certain types of cancer. This, along with other health problems, has been identified as clearly warranting further epidemiological research in order to identify the significant contributing factors.

Nature of Impact: Not currently known.

Socio-Economic Impacts (Chapter 12)

Delaware City's economy has been aided, overall, by the location of the Getty refinery, although certain factors have tended to diminish the positive economic impacts. At the same time, the refinery, even in conjunction with the "satellite" industries which located at Delaware City as a result of the refinery's presence, does not appear to be a dominant force in the community's social and economic life. The specific areas of impact are as follows:

1. Employment - positive.
2. Retail Trade - positive.
3. Real Estate Values - negative.

Community Service and Fiscal Impacts (Chapter 13)

1. The City government has received in excess of $700,000 in tax revenues from the Getty refinery during the past 26 years, for which Getty has not received any substantial municipal services.

Nature of Impact: Positive.

2. Delaware City has received additional revenues from the provision of miscellaneous services to Getty, including mowing, sweeping, and the sale of water.

Nature of Impact: Positive.

3. Delaware City has received a number of contributions, loans, and corporate gifts from Getty, which have helped to enhance the provision of community services.

Nature of Impact: Positive.

4. Delaware City's municipal bond rating and debt limit have been enhanced by the value of Getty's property within the corporate limits.

Nature of Impact: Positive.

5. The effect of Getty's groundwater withdrawal has resulted in higher costs to the City to pump water for the municipal water supply, as previously mentioned.

Nature of Impact: Negative.

6. The extent to which the refinery's presence has contributed to the depression of Delaware City real estate values, has also affected the City's property tax revenues.

Nature of Impact: Negative.

7. The development and presence of the refinery has had an adverse effect on certain recreational opportunities, as discussed below.

Recreational and Cultural Impacts (Chapter 14)

1. Delaware City's capability to finance the development and maintenance of parks and other recreational facilities, has been increased by Getty's tax payments.

Nature of Impact: Positive.

2. Getty's donations of a building for use as a community center and a parcel of land for use as a baseball field have enhanced recreational opportunities.

Nature of Impact: Positive.

3. The development of the refinery resulted in the loss of open space resources for community recreational use.

Nature of Impact: Negative.

4. Getty is responsible for the destruction of two historically significant structures, Lexington and Marl Dale, which has resulted in the loss of part of the community's cultural heritage.

Nature of Impact: Negative.

5. Getty's contribution to the deteriorated condition of water quality in the Delaware River has resulted in the loss of certain water-based recreation opportunities.

Nature of Impact: Negative.

Potential Disaster Impacts (Chapter 15)

1. Short-term potential impacts on Delaware City resulting from a disaster at the refinery could involve significant damage to the waterfront area, including Battery Park and residential and commercial structures on Washington and Clinton Streets.

Nature of Impact: Potentially Negative.

2. Long-term potential impacts could involve increased levels of anxiety among Delaware City residents relative to their safety. Additionally, the image of Delaware City as perceived by people from the outside, could be impaired relative to the attractiveness and safety of tourist visitation.

Nature of Impact: Potentially Negative.

PART III

RECOMMENDATIONS

CHAPTER 17

SUMMARY OF RECOMMENDATIONS

INTRODUCTION

A number of the preceding chapters which have focused on the identification of specific impacts on Delaware City as a result of the operation of the Getty refinery, have also presented specific recommendations. These recommendations have been formulated for one of three purposes:

1. To reduce, eliminate, or prevent negative impacts on the community resulting from the refinery;

2. To enhance positive impacts on the community resulting from the refinery; or

3. To address other related problems and issues uncovered during investigations into potential areas of Getty-related impacts.

All of these recommendations have been collected from the various chapters, and are presented below, organized according to their purpose. It should be emphasized that each of these recommendations has been formulated to be implementable by the Mayor and Council of Delaware City and is intended to assist in the improvement of the quality of life in the community. For complete statements and specifications relative to each recommendation, reference should be made to the "CONCLUSIONS" section of the appropriate chapter.

RECOMMENDATIONS TO REDUCE, ELIMINATE, OR PREVENT NEGATIVE IMPACTS

Air Quality (Chapter 5)

It is recommended that Delaware City:

1. Get involved in the process by which the State Department of Natural Resources and Environmental Control (DNREC) grants variances that allow Getty to temporarily exceed air emissions standards. This will enable the City to register its concerns and comments at public hearings before a variance is granted;

2. Seek technical assistance and support from Delaware Citizens for Clean Air, an area interest group which is very familiar with the legal and scientific aspects of the air pollution problem;

3. Establish a direct relationship with the DNREC's Environmental Protection Officer assigned to the Delaware City area, in order to most effectively report incidents of visible pollution (opacity violations), dust or silt problems, and offensive odors; and

4. Obtain a legal opinion on the power of the Delaware City Board of Health to regulate odors emanating from the refinery.

Water Resources (Chapter 6)

It is recommended that Delaware City establish direct relations with officials of the DNREC Water Supply Branch in order to be kept informed of proposed changes in Getty's water resource usage which may affect water supply or quality in the community.

Visual Quality (Chapter 7)

It is recommended that Delaware City:

1. Request the Getty refinery management to consider the installation of landscape screening along the borders of several refinery operations areas. Priority should be given to the interface between the marine terminal and the remainder of the town's waterfront area. Secondary attention should be given to the cyclone fencing along the Clark's Corner to Delaware City Road; and

2. Consider the development and adoption of a landscape screening regulation which can be incorporated into the existing zoning code.

Disaster (Chapter 15)

It is recommended that Delaware City:

1. Encourage the refinery management to acquire a boat with firefighting capability;

2. Independently develop an emergency plan to help the community respond in case of a refinery fire or explosion which may threaten the community; and

3. Seek financial support to increase the ambulance service available to the community through the Delaware City Volunteer Fire Company.

RECOMMENDATIONS TO ENHANCE POSITIVE IMPACTS

Socio-Economic (Chapter 12)

It is recommended that Delaware City appeal to representatives of the management of the Getty refinery, possibly in conjunction with representatives of the "satellite" petrochemical firms, to explore ways of increasing employment opportunities for qualified Delaware City residents.

Community Services and Fiscal (Chapter 13)

It is recommended that Delaware City seek additional financial support for community improvement projects from the refinery management through non-tax-related mechanisms, such as corporate gifts, contributions, or donations. Such efforts should conform to established principles of proposal development and should reflect proposed projects which coincide with priority areas identified as part of the company's charitable contributions policy.

Recreational and Cultural (Chapter 14)

It is recommended that Delaware City undertake the planning and seek financial support necessary to improve the accessibility of the ballfield located on land donated to the City by Getty.

OTHER RECOMMENDATIONS

A set of additional recommendations has been developed as part of the conduct of

this study, to address problems confronting the community which may not be a direct or exclusive consequence of the operation of the Getty refinery. Nevertheless, these problems came to the attention of the Consultant in the course of identifying refinery-related impacts on the community. The following recommendations are presented toward the resolution of these problems, with the intended outcome of further improving the quality of life for Delaware City residents.

Shoreline Erosion and Flood Hazards (Chapter 4)

It is recommended that Delaware City seek the funding to implement a tidal erosion and flood protection project. This comprehensive project, which would require the cooperation and support of the Getty Refining and Marketing Company, the Formosa Plastics Company, and the U.S. Army Corps of Engineers, would include the following elements:

1. Enhance the existing groin at Baby Beach (foot of Washington Street) by the positioning of new stone riprap on the groin. This material should meet Delaware Department of Transportation Standard Specifications (refer to Plate 1 in Appendix A);

2. Construct bulkheading across the "Stauffer Slip" and the back portion of Baby Beach at Washington Street, connecting with the Getty marine terminal. This project would extend the sea wall which currently ends at Battery Park, thereby better protecting the waterfront from the effects of storm flooding. A portion of the bulkhead can be designed to be removable, to accommodate the occasional use of this area by Getty to beach heavy equipment (refer to Figure 4, Chapter 4, and Plate 1 in Appendix A);

3. Increase the elevation of the existing riprap dike immediately south of the Fort Delaware Park building to +9 feet (see Figure 5, Chapter 4, and Plate 1 in Appendix A);

4. Construct a two-foot concrete cap on the existing bulkhead along the branch channel of the canal similar to that used along Battery Park (see Figure 6, Chapter 4, and Plate 1 in Appendix A);

5. Construct a new section of bulkhead along the branch channel of the canal, extending from William Street to Fourth Street. The existing boat ramp near William Street should be relocated beyond the terminus of the proposed bulkhead (see Plate 1, in Appendix A); and

6. Replace the existing flap gate system at Washington Street and the "Stauffer Slip" with a new outlet system designed to be integrated with the proposed bulkhead. The new system would include two new flap gates (slant types, as opposed to the existing vertical types), a new junction box, and new piping (see Plate 2, in Appendix A).

Engineering recommendations and plans which have been developed to assist in the implementation of this project, include the following cost estimates:

Erosion Control Improvements (element 1)	$ 34,000
Stage I Bulkhead Improvements (element 2)	174,900
Stage II Bulkhead Improvements (elements 3-5)	869,900
Drainage System Improvements (element 6)	10,000
Total Estimated Cost of Tidal Erosion and Flood Protection Project:	**$1,088,800**

Water Resources (Chapter 6)

It is recommended that Delaware City arrange to have a thorough chemical analysis performed on groundwater supplies which serve the municipal water system. This analysis should be set up to test for the presence of a wide range of contaminants which have been detected in groundwater supplies in the vicinity of the Llangolen and Tybout's Corner landfills, including heavy metals and PCB's (Polychlorinated Biphenyls). Testing should also be done for lead and chlorides (salt). The analysis can serve as a baseline for tests at periodic intervals in future years. Contact should be made with Mr. Harry Otto of the Technical Services Section of the State Division of Environmental Control to obtain technical assistance.

Land Use (Chapter 8)

It is recommended that Delaware City:

1. Modify the zoning code by reorganizing the existing M-1 (Light Manufacturing) district to reflect light industrial uses, and creating a new M-R (Manufacturing-Refinery) district to reflect industrial land uses at the Getty Refinery; and

2. Rezone certain Getty lands within the corporate limits of Delaware City so as to more realistically reflect their uses.

Community Leadership (Chapter 10)

It is recommended that the Mayor and Council of Delaware City, in cooperation with the management of the Getty refinery, execute a compact which identifies areas of shared purpose and which includes procedures for the resolution of conflicts between the refinery and the town.

Health (Chapter 11)

It is recommended that Delaware City:

1. Undertake a comprehensive epidemiological study of residents of the community, to determine whether any unusual or significant health problems exist. Sources of funding and technical assistance, identified in Chapter 11, should be contacted;

2. Establish a comprehensive information and recordkeeping system to maintain the medical histories and other pertinent information for all town residents who have been diagnosed as having cancer, cardiovascular disease, or respiratory disease. This system should be developed in conjunction with recommendation #1 above, and can be maintained by the Delaware City Health Clinic, assuming adequate financial and staff support is obtained; and

3. Conduct a survey of all households in the community, to identify persons with a potentially high risk of contracting cancer. Such a survey should be accompanied by a highly-visible educational campaign.

Socio-Economic (Chapter 12)

It is recommended that Delaware City:

1. Undertake a comprehensive commercial revitalization planning study organized to:

- Establish a baseline of detailed, up-to-date information on trade characteristics and trade volumes among the town's commercial establishments;

- Assess the local demand for retail and wholesale goods and services which is currently not being met; and

- Develop a strategy for encouraging the expansion of existing firms and/or the location of new firms, in order to meet whatever unsatisfied demand has been identified; and

2. Develop a promotional strategy or campaign to enhance tourism to the town.

Recreational and Cultural (Chapter 13)

It is recommended that Delaware City:

1. Complete the improvement of recreational facilities on City-owned parkland, wherever such facilities are currently incomplete;

2. Increase the accessibility of the Delaware City Touch Museum by increasing financial support and volunteer staffing;

3. Renew efforts to obtain the designation of an historic district in the town from the National Trust for Historic Preservation;

4. Establish an historic district zoning code classification, to be incorporated into the existing zoning code; and

5. Develop plans and implementation strategies for a new water-based recreational facility, to be located on City-owned property along the branch channel of the canal. Such a facility could be planned to include swimming, fishing, and a public launch area for boats (to replace the current launch so as to correspond with recommended flood protection improvements).

APPENDIX A

PLATES 1 AND 2

APPENDIX B

STANDARDS AND REGULATIONS

STATE OF DELAWARE
REGULATIONS GOVERNING THE CONTOL OF AIR POLLUTION

REGULATION NO. VI

PARTICULATE EMISSIONS FROM CONSTRUCTION AND MATERIALS HANDLING

Section 1 - General Provisions

1.1 The purpose of this Regulation is to control particulate emissions from construction and materials handling operations to a limit so as not to cause a condition of air pollution.

Section 2 - Demolition

2.1 No person shall cause or allow the demolition of existing structures, buildings, or parts of buildings, in New Castle County or in incorporated areas of Kent and Sussex Counties unless methods are employed to control dust emissions.

2.2 Such methods may include the application of water or the use of other techniques approved by the Department.

2.3 The restriction in Subsection 2.1 may be extended to unincorporated areas of Kent and Sussex Counties in situations where the Department determines that demolition activities could emit dust in quantities sufficient to cause air pollution.

Section 3 - Grading, Land Clearing, Excavation and Use of Non-Paved Roads

3.1 No person shall cause or allow land clearing, land grading (including grading for roads), excavation, or the use of non-paved roads on private property unless methods, as indicated in Subsection 2.2, are employed to control dust emissions, when the Department determines that such activities could emit dust in quantities sufficient to cause air pollution.

Section 4 - Material Movement

4.1 No person shall cause or allow visible particulate emissions of any material being transported by a motor vehicle.

Section 5 - Sandblasting

5.1 No person shall cause or allow sandblasting or related abrasion operations unless sufficient contaminant measures are taken to prevent the sand and/or abrasive material from traveling beyond the property line where the operation is being conducted.

Section 6 - Material Storage

6.1 No person shall cause or allow stockpiling or other storage of material or transport to or from a storage facility in such a manner as may cause a condition of air pollution.

NEW CASTLE COUNTY
STANDARD AND SPECIFICATIONS GUIDE FOR
DUST CONTROL

Definition

Controlling dust blowing and movement on construction sites and roads.

Purpose

To prevent blowing and movement of dust from exposed soil surfaces, reduce on and off-site damage, health hazards and improve traffic safety.

Conditions Where Practice Applies

This practice is applicable to areas subject to dust blowing and movement where on and off-site damage is likely without treatment.

Specifications Guide

Temporary Methods:

A. Mulches - See standards for critical area stabilization with mulches only. Chemical mulch binders may be used instead of asphalt to bind mulch material. Binders such as Curasol or Terratack should be used according to manufacturer's recommendations.

B. Vegetative Cover - See standards for temporary vegetative cover.

c. Spray-on Adhesives - On mineral soils (not effective on muck soils). Keep traffic off these areas.

	Water Dilution	Type of Nozzle	Apply-Gal./Ac.
Anionix asphalt emulsion	7:1	Coarse spray	1,200
Latex emulsion	121/2:1	Fine spray	235
Resin-in-water emulsion	4:1	Fine spray	300

D. Tillage - to roughen surface and bring clods to the surface. This is an emergency measure which should be used before soil blowing starts. Begin plowing on windward side of site. Chisel-type plows spaced about 12" apart, spring-toothed harrows, and similar plows are examples of equipment which may produce the desired effect.

E. Irrigation - this is generally done as an emergency treatment. Site is sprinkled with water until the surface is wet. Repeat as needed.

F. Barriers - Solid board fences, snow fences, burlap fences, crate walls, bales of hay and similar material can be used to control air currents and soil blowing. Barriers placed at right angles to prevailing currents at intervals of about 15 times their height are effective in controlling soil blowing.

G. Calcium Chloride - Apply at rate that will keep surface moist. May need retreatment.

Permanent Methods:

A. Permanent Vegetation - See standards for permanent vegetative cover, and permanent stabilization with sod. Existing trees or large shrubs may affort valuable protection if left in place.

B. Topsoiling - covering with less erosive soil material. See standards for topsoiling.

C. Stone - cover surface with crushed stone or coarse gravel.

References

Agriculture Handbook 346

Wind Erosion Forces in the United States and their Use in Predicting Soil Loss.

Agriculture Information Bulletin 354
How to Control Wind Erosion
USDA-ARS

APPENDIX C

CORRESPONDENCE

Greenwood Laboratories

ANALYTICAL CHEMISTS AND CONSULTANTS

903 E. BALTIMORE PIKE KENNETT SQUARE, PA. 19348

PHONE: 215-388-7295

TO: Richard A. Gilbert, Jr.
City Manager
City of Delaware City
407 Clinton Street
Delaware City, DE 19706

FROM: Gerald R. Umbreit, Ph.D.

DATE: May 2, 1980 GREENWOOD NO. GL 4391 & GL 4416

SUBJECT: Examination of soil and dust samples for possible content of PCB's.

SAMPLES: GL 4391: Silt sample (rec'd 4/15/80)

GL 4416-1: Sample A (from DMSA #3A Area) (rec'd 4/28/80)
GL 4416-2: Sample B (" " " ") "
GL 4416-3: Sample C (from private residence) "
GL 4416-4: Sample D (" " " "

SUMMARY:

The sample designated GL 4391 was first submitted on April 15, 1980. This sample was examined by gas chromatography with electron capture detection. The sample was prepared by leaching an accurately weighed 4 gram portion with 4 ml of iso-octane. The resulting solution was analyzed and showed a chromatographic pattern corresponding in significant, though not total detail with Aroclor 1248 (PCB). The estimated quantity of detected material, as Aroclor 1248, is 80 ppm.

Because of this observation, the additional samples, designated GL 4416, were submitted. There is no correlation between the first sample and any of the subsequent series of samples. Specifically, the two samples designated from "DMSA #3A Area" (A & B) show only a single component which therefore does not correspond to PCB's which are mixtures. This component is not identified except to recognize that it is responsive to electron capture detection, a property commonly ascribed to polychlorinated compounds. On an assumed basis of signal to weight equal to that of DDT, this detected component represents approximately 1 ppm in each sample and may be material resulting from the planting of insecticide-treated seed. Seeding of the source of these samples shortly prior to sampling was indicated during the telephone conversation with you.

Sample C shows two primary and six lesser components. These bear no relationship either to samples A, B and D, nor to the sample designated GL 4391. The components detected again are unidentified except to note that they do not correspond with any of the standard PCB mixtures which we have available for reference. On the

same assumed basis of signal to weight equal to that of DDT, the two primary components in this sample represent 1 to 2 ppm each; six lesser components detected likely do not exceed a total of 0.4 ppm.

Finally, Sample D, when processed and analyzed as all the remainder of these samples, shows no significant signal.

Therefore, if there is truly PCB contamination at the source of sample GL 4391, it clearly is not derived from the dredged material which was initially under suspicion. Further, what contamination this may represent is clearly not generalized over any significant area of Delaware City and may indeed be restricted solely to the part of a single home from which that sample was obtained.

Gerald R. Umbreit

Gerald R. Umbreit, Ph.D.
GREENWOOD LABORATORIES

GRU:del

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION III
6TH AND WALNUT STREETS
PHILADELPHIA, PENNSYLVANIA 19106

JUN 04 1980

Mr. Richard Gilbert
City Manager
407 Clinton Street
Delaware City, Del. 19706

Dear Mr. Gilbert:

In response to your inquiry regarding trace metals in fugitive dust, I have assembled the applicable standards and have compared them to the values that you provided in our phone conversation. All the applicable standards are in the form of ambient air concentrations. Micrograms/cubic meter (ug/m^3). Therefore, in order to make a comparison with the data provided, some assumptions had to be made.

First, it was assumed that the concentration of trace metals in the air are roughly in the same proportions as the analysis of the dust indicated. This is not really valid, since the larger particles would not be suspended in the air, and therefore dilute the sample somewhat. In order to calculate a concentration for the trace metals, a total suspended particulate (TSP) level had to be chosen. A concentration of 400 microgram/cubic meter was used for this purpose. The NAAQS primary standard for TSP is 260 ug/m^3. Therefore, the particulate concentration chosen would represent a violation. The 400 ug/m^3 was used since it represents the highest individual reading reported in Delaware for a selected 3 month period. The proportions indicated by the dust analysis were used to calculate the concentrations of the individual trace metals as follows:

$$\frac{400 \text{ ug gr.}}{m^3} \text{ TSP } X \frac{40 \text{ lead}}{1{,}000{,}000 \text{ Total Solids}} = .016 \text{ ug/m}^3$$

The following table lists the (trace metal analysis) data supplied and the corresponding estimated air concentrations calculated by the above method.

Analysis for trace metals:

		Estimated Air Concentration
Lead	40 ppm	.016 ug/m^3
Cadmium	0.85 ppm	.00034 ug/m^3
Chromium	38 ppm	.0152 ug/m^3
Zinc	135 ppm	.054 ug/m^3
Mercury	<1 ppm	

The table below lists the various standards for the trace metals and compares them with the estimated air concentrations.

	90(Day) NAAQS	NIOSH	8(Hr) OSHA
Lead	1.5 ug/m^3	150 ug/m^3	50 ug/m^3
Cadmium		40 ug/m^3	200 ug/m^3
Chromium (VI)		1 ug/m^3	10 ug/m^3
Chromium (other)		25 ug/m^3	
Mercury (in organic)		50 ug/m^3	100 ug/m^3 (10 min)
Zinc (ZnO)		500 ug/m^3	500 ug/m^3

As the above table indicates, only lead has a National Ambient Air Quality Standard (NAAQS). This standard is based on a 90 day average. The other standards listed are those of the National Institute for Occupational Safety and Health (NIOSH), which is a research arm of the Occupational Safety and Health Administration (OSHA). All the standards listed for NIOSH and OSHA are for 8 hour averages, except for those with specified time periods. These represent maximum ceiling concentrations for the specified time period of exposure.

To aid you in the evaluation of any possible health hazard that might be present, I have included some results of some sampling done on street dirt samples in Philadelphia. These figures represent averages for a varying number of samples and are not the result of an exhaustive study but are provided for comparison purposes.

Philadelphia Street Dirt (ppm)

	(1)	(2)	(3)
Lead	2200	6900	15,800
Cadmium	7.8	14	31
Chromium	40	96	220
Zinc	1300	-	-

(1) ppm by weight of total solids.

(2) Analysis of solids $<$44 u (microns).

(3) Acid soluble material only. (No silica or inerts)

As you can see, the levels of trace metals in the street dirt are significantly higher than the sample from Delaware City for all metals other than chromium. It would appear from this data that the levels of the trace metals found in the particulate matter found in the vicinity of the dredge piles are lower or equal to those of normal street dirt. Based upon these results, I see no need for further samples or analyses as the trace metal content of the particulate is not a cause for concern.

If you have any further questions on this or any other air pollution matter, please feel free to contact this office again.

Sincerely yours,

George Fekete
Air Analysis & Energy Section

APPENDIX D

ODOR SURVEY QUESTIONNAIRE

"A Historic Past"

"A Bright Future"

April 1, 1981

CITY OF DELAWARE CITY
407 Clinton Street
Delaware City, Delaware 19706

Dear Neighbor:

As part of a study presently being conducted for our community, we would like to obtain your opinions about possible odors in the air near your home. We would very much appreciate your participation in this survey.

All that you need to do is to answer the several questions below, to the best of your ability. In answering these questions, we would like you to think of any odor problems that you notice in the vicinity of your home.

After you have completed the questions, please place this sheet in the envelope we have provided, and bring it to the Town Hall. If you would rather, you can mail it to us, making sure that the Town Hall address on the back of this sheet appears in the window of the envelope (you must also place a postage stamp on the envelope!)

Please return your questionnaire to us by Friday, April 16, 1982. Thank you very much for your participation in the survey.

Sincerely,

Sylvia A. Maxey
City Manager

1. Using the attached map of Delaware City, please indicate the Section Number which shows the section of town in which you live.
   Section Number____

2. Do you, or have you in the past, noticed any unpleasant odors in the outside air around your home? ____Yes ____No ____Not Sure
(Please check one)

3. How would you describe the "smell" of the air outside your home? (Please check one)
   ____the air usually has a pleasant odor.
   ____the air usually has no odor.
   ____the air usually has a slightly unpleasant odor.
   ____the air usually has a very unpleasant odor.

4. How often does the air outside your home "smell" unpleasant?
   ____never or almost never
   ____sometimes
   ____often or very often